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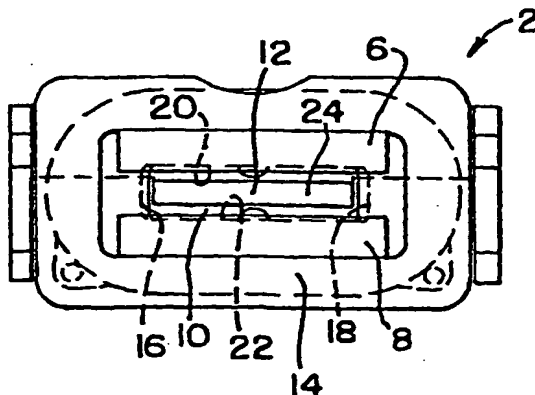
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(54) Title: **TRANSDUCER WITH RESISTANCE TO SHOCK**



(57) Abstract: A transducer comprising a pair of spaced magnets at least partially forming a tunnel having a central axis. A coil having a first and a second side wall and an upper and a lower wall at east partially forms the tunnel. A reed having a central portion extends through the tunnel. The reed has a stationary end, a deflection end, and a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets.

## TRANSDUCER WITH RESISTANCE TO SHOCK

### DESCRIPTION

#### Related Applications

This application claims priority to U.S. Provisional Patent Application entitled "Transducer With Resistance To Lateral Shock," Serial No. 60/158572, filed October 7, 1999 and U.S. Provisional Patent Application entitled "Transducer With Resistance To Shock," Serial No. 60/180547, filed February 7, 2000. Both applications and U.S. Patent No. 5,647,013, entitled "Electrostatic Transducer," issued July 8, 1997, are incorporated herein.

#### Technical Field

This invention relates to a transducer, suitable for use within hearing aids, for reducing shock.

#### Background of the Invention

It is known that transducers include a coil with a first air gap or tunnel, magnetic members, such as spaced apart permanent magnets, having a second air gap or tunnel, and a reed armature. The first and second air gaps are generally aligned, with the armature reed extending through the first and second air gaps.

The arrangement is such that when the moving part of the reed shifts in one direction or another away from a centralized position between the two poles, the magnetic flux is caused to flow in one direction or the other along the reed and hence through the coil. The reed is attached to a diaphragm and in this way the vibrations of the diaphragm caused by received sound are converted into corresponding currents in the coil or vice versa. If the transducer experiences a shock e.g., from being dropped, the reed can be easily damaged due to over deflection or unwanted deflection in the horizontal and/or vertical directions. In addition, the tip portion of the reed may strike the magnet with considerable force

on the upper or lower side walls of the tunnel formed within the coil. Reference can be made to U.S. Patent No. 5,647,013 for one such arrangement.

To reduce and prevent unwanted deflection of the armature's reed, the tunnel of the transducer can be tapered (inwardly or outwardly) from the fixed or stationary end of the armature toward the deflection end of the reed. In addition, a contact point can extend into the tunnel to reduce or prevent unwanted horizontal deflection of the armature reed. These previous techniques still require the reed to contact the surface of the tunnel and this contact can cause damage to the reed.

This invention is designed to prevent these and other problems.

#### Summary of the Invention

According to a first embodiment of the present invention, a transducer resistant to shock comprises a stack having a pair of spaced magnets at least partially forming a tunnel. The tunnel has a central axis and the magnets have an upper and a lower tunnel wall. A coil at least partially forms the tunnel. The coil has a first and a second side wall and an upper and lower wall. Extending through the tunnel is a reed having a central portion, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets. The reed is mounted for deflection towards or away from the magnets. A shock protective means is responsive to a shock impulse to the transducer where upon the protective means engages the reed. Preferably, the shock protective means comprises a ring fixedly attached between the coil and the stack. At least one bumper is attached to the ring in close proximity to the reed wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.

Another embodiment of the present invention is directed to a transducer comprising a pair of spaced magnets at least partially forming a tunnel. The tunnel has a central axis. A coil having a first and a second side wall and an upper and

lower wall at least partially forms the tunnel. A reed having a stationary end, a deflection end, and a central portion, extends through the tunnel. A tip portion of the reed lies at least partially between the magnets. The reed is mounted for deflection towards or away from the respective magnets. The coil has a first end toward the stationary end of the reed and a second end toward the magnets, wherein at least one side wall of the coil is tapered (inwardly or outwardly) from the central axis from the first end of the coil to the second end of the coil.

Other advantages and aspects of the present invention will become apparent upon reading the following description of the drawings and detailed description of the invention.

#### Brief Description of the Drawings

FIGURE 1 is front view of the present invention;

FIGURE 2 is a rotated top view of the present invention shown in FIGURE 1;

FIGURE 3 is an enlarged view of FIGURE 1;

FIGURE 4 is an enlarged view of FIGURE 2;

FIGURE 5 is a cut-away side view of the present invention;

FIGURE 6 is a front view of a coil winding bobbin for the present invention;

FIGURE 7 is a rear view of the coil winding bobbin shown in FIGURE 6;

FIGURE 8 is a cross section view of the coil winding bobbin shown in FIGURE 7 along the line 8-8;

FIGURE 9 is a cross section view of the coil winding bobbin shown in FIGURE 7 along the line 9-9;

FIGURE 10 is a side cut-away view of a portion of the present invention;

FIGURE 11 is a view of one embodiment of a magnet of the present invention;

5           FIGURE 12 is a partial side cut-away view of an alternative embodiment of the present invention;

FIGURE 13 is a partial side cut-away view of an alternative embodiment of the present invention;

10           FIGURE 14 is a partial side cut-away view of an alternative embodiment of the present invention;

FIGURE 15 is partial view of a magnet of an alternative embodiment of the present invention;

FIGURE 16 is partial view of a magnet of an alternative embodiment of the present invention;

15           FIGURE 17 is a front view of an alternative embodiment of the present invention;

FIGURE 18 is a front view of an alternative embodiment of the present invention;

20           FIGURE 19 is a front view of an alternative embodiment of the present invention;

FIGURE 20 is a front view of an alternative embodiment of the present invention;

FIGURE 21 is a side view of an alternative embodiment of the present invention;

25           FIGURE 22 is a side view of an alternative embodiment of the present invention; and,

FIGURE 23 is a front view of an alternative embodiment of the present invention.

#### Detailed Description

5 While this invention is susceptible of embodiment in many different forms, there is shown in the drawings and will herein be described in detail preferred embodiments of the invention with the understanding that the present disclosure is to be considered as an exemplification of the principles of the invention and is not intended to limit the broad aspect of the invention to the  
10 embodiments illustrated.

Figure 1 is a front view of a transducer 2 with its housing 4 (see Figures 17 and 18) removed. Figure 2 is a top/rotated view of the transducer of Figure 1. Figure 3 is an enlarged view of Figure 1, and Figure 4 is an enlarged view of Figure 2. Figure 5 is a cut-away side view of the transducer of Figure 1.

15 The transducer 2 of these figures has a pair of spaced magnets 6, 8 at least partially forming a tunnel 10. The tunnel having a central axis 12. The transducer 2 further has a coil 14 at least partially forming the tunnel 10. The coil has a first and a second side wall 16, 18 and an upper and lower wall 20, 22. The transducer 2 further has a reed 24 having a central portion 26 which extends  
20 through the tunnel 10, a stationary end 28, and a deflection end 30. The reed 24 has a tip portion 30 which lies at least partially between the magnets 6,8. The reed 24 is mounted for deflection towards and/or away from the respective magnets 6, 8.

25 The coil 14 has a first end 32 toward the stationary end 28 of the reed 24 and a second end 34 toward the magnets 6,8. The side walls 16, 18 of the coil 14 are tapered inwardly toward the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal

deflection of the reed 24. Alternatively, the side walls 16, 18 of the coil 14 can be tapered outwardly away from the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Alternatively, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered outwardly away from the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Likewise, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered inwardly toward the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. For the above alternatives or other alternatives, having a coil wall, or any part or stretch thereof, that is tapered, the coil wall can further have a separate raised portion toward the central axis 12, in relation to the adjacent portion of the wall thereof.

Some of the Figures depict dimensions which can be used for the present invention. Other dimensions can be used as well. For the embodiments in Figures 1 through 5, one set of dimensions are as follows: the nominal lateral reed clearance is  $0.0625 \text{ in. (nominal tunnel width)} - 0.0595 \text{ in. (nominal reed width)} = 0.003 \text{ in. (0.0015 in. per side)}$ . Coil tunnel taper is  $0.0045 \text{ in. over } 0.093 \text{ in. length}$ , or about  $2.8^\circ$ . The nominal reed to rib (top or bottom of the coil) is  $0.0111 \text{ in. (nominal rib gap)} - 0.008 \text{ in. (nominal reed thickness)} = 0.0031 \text{ in. (0.0015 in. top / bottom)}$ .

Figure 6 is a front view of a further coil winding bobbin for a transducer 2 of the present invention. Figure 7 is a back view of the coil winding bobbin of Figure 6. Figure 8 is a side view of the coil winding bobbin of Figure 6. Figure 9 is a top view of the coil winding bobbin of Figure 6. These figures show one tapering that can be implemented within the coil winding for the present invention.

Figure 10 is a side cut-away view of a portion of the transducer of the present invention. The transducer 2 therein has a pair of spaced magnets 6, 8. The magnets, 6,8 have upper and lower tunnel walls 40, 42. The magnets have a second end 44 toward the deflection end of the reed, and a first end 46 toward the coil 14. The upper and the lower tunnel walls 40, 42, or at least a part or stretch thereof, of the magnets 6,8, are tapered outwardly from the central axis 12, in a direction from the first end 46 of the magnets to the second end 44 of the magnets. This creates a possible contact point(s) 50 for the reed 24, depending on the angle of tapering. Preferably, with the proper angle of tapering, the reed 24 will not only contact at the contact point(s) 50, the reed 24 will contact along a significant or even the entire length of the magnets 6,8. In another embodiment, the tapering can take place in the opposite direction.

Figure 10 further shows that the transducer 2 has a first and second (upper and lower) yoke portions 60, 62, which can comprise a stack, as is known in the art. Figure 11 is a magnet 6,8 indicating one set of measurements for one or both of the magnets 6,8 in view of Figure 10. Figure 12 shows an alternative to the transducer of Figure 10. This embodiment has a shim 70 between the first yoke portion 60 and the magnet 6. The shim 70 causes at least one of the upper and the lower tunnel walls 40, 42, or a part of a stretch thereof, of the magnets 6,8, to be tapered outwardly from the central axis 12, in a direction from the first end of the magnets to the second end of the magnets. The shim 70 could be placed in the opposite direction, between the magnet 6 and respective yoke portion 60, to reverse the tapering.

Figure 13 shows a further embodiment of the transducer of Figure 10, the main difference being that the tapering is caused by the yoke portion being tapered instead of the magnets being tapered. It should be understood that both the yoke portion and the magnet could be tapered to achieve the same tapering effect.



Figures 14, 15, and 16 show further embodiments of the transducer 2 of present invention. The upper and lower tunnel walls 40, 42 of the magnets 6,8 have a raised portion 80 inwardly toward the central axis 12 toward the first end 46 of the magnets 6,8. The raised portion 80 can extend substantially the width of the tunnel, as shown in Figure 15, or less than the entire width, as shown in Figure 16. It should be understood that the raised portion can be provided at or along other areas of the upper and/or lower tunnel walls 40, 42.

Figures 17 and 18 show further embodiments of the transducer of the present invention. The transducer 2 has a housing 4. An armature 90 has a reed 92, and a first leg 94 and a second leg 96 extending along opposed sides of the exterior of a coil 14 and a yoke 60. Spacers 100, which can be comprised of a resilient epoxy or RTV, are position between the housing 4 and the first and second legs 94, 96 of the armature 90. Figure 18 shows that another spacer 100 can be positioned between the housing 4 and the armature 90 adjacent the stationary end of the reed 92.

Active shock protection means 104 of the armature's reed 24 can be incorporated as an alternative to the spacers 100. The shock protection means 104 is idle until a shock is absorbed by the transducer 2. FIGURE 19 is a front view of an alternative embodiment of the present invention having shock protective means 104. The shock protective means 104 comprises a pair of bumpers 110 on opposing sides 120, 122 of a reed 24. The shock protective means 104 will reduce and prevent unwanted movement of the reed 24 caused by a shock impulse. Under normal conditions, the active bumpers 110 remain out of contact with the reed 24 as depicted in FIGURE 19. As the transducer 2 receives a shock impulse, the active bumpers 110 will engage the reed 24 to prevent damage by clamping or inhibiting the reed 24 from movement.

Preferably, the shock protective means 104 includes a ring 106, preferably metal, circumferentially positioned about the central axis 12 of the tunnel 10. The ring 108 has opposing upper 120 and lower 122 walls; and opposing side walls 116, 118. Extending from the upper 120 and lower 122 walls of the ring 106 and toward the armature's reed 24 is a bumper 110. Each bumper 110 is attached to the upper 120 and lower 122 wall of the ring 106 by a flexible band 126, preferably made of flurosilicon. The flexible band 126 may be molded directly onto the ring 106 and the bumpers 110 by Flexan (TM). The bumpers 110 remain away from the reed 24 until the transducer 2 encounters a vertical shock impulse.

As the transducer 2 receives a vertical shock impulse, the protective bumpers 110 of the shock protective means 104 respond to the vertical shock impulse and move to engage the reed 24. FIGURE 20. It is to be understood that although the present embodiment discloses the active shock protective means 104 as having a pair of bumpers 110 on opposing sides 120, 122 of the reed, the present invention includes alternative embodiments having at least one bumper 110 in close proximity to the reed 24 so as to engage the reed 24 in response to a shock impulse. Another alternative embodiment shown in FIGURE 23 depicts shock protective means 104 having a molded flexible gasket 112.

The active shock protective means 104 can be positioned between the stack and the coil 14. FIGURE 21. Alternatively, the active shock protective means 104 can be positioned at the end of stack near the deflection end 30 of the reed 24. FIGURE 22.

While the specific embodiments have been illustrated and described, numerous modifications come to mind without significantly departing from the spirit of the invention and the scope of protection is only limited by the scope of the accompanying claims.

### CLAIMS

#### WE CLAIM:

1. A transducer comprising:
  - a stack having a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;
  - a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;
  - a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the magnets; and,
  - shock protective means wherein the protective means is responsive to a shock impulse to the transducer where upon the protective means engages the reed.
2. The transducer of claim 1 wherein the shock protective means comprises:
  - a ring fixedly attached between the coil and the stack; and,
  - at least one bumper attached to the ring in close proximity to the reed, wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.
3. The transducer of claim 1 wherein the shock protective means comprises:
  - a ring fixedly attached between the coil and the stack;
  - a first and second bumper, the first bumper is attached to the upper wall of the ring and the second bumper is attached to the lower wall of the ring, wherein the

bumpers are responsive to an impulse shock to the transducer and the bumpers act to contact the reed.

4. The transducer of claim 2 wherein the ring is a metal.
5. The transducer of claim 3 wherein the ring is a metal.
6. The transducer of claim 1 wherein the shock protective means comprises:
  - a ring fixedly attached to the stack near the deflective end of the reed; and,
  - at least one bumper attached to the ring in close proximity to the reed, wherein the at least one bumper is responsive to an impulse shock to the transducer and the bumper acts to contact the reed.
7. The transducer of claim 1 wherein the shock protective means comprises:
  - a ring fixedly attached to the stack near the deflective end of the reed; and,
  - a first and second bumper, the first bumper is attached to the upper wall of the ring and the second bumper is attached to the lower wall of the ring, wherein the bumpers are responsive to an impulse shock to the transducer and the bumpers act to contact the reed.
8. The transducer of claim 6 wherein the ring is a metal.
9. The transducer of claim 7 wherein the ring is a metal.
10. A transducer comprising:

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, and wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets.

11. The transducer of claim 10 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

12. The transducer of claim 10 wherein at least one side wall of the coil is tapered outwardly from the central axis from the first end of the coil to the second end of the coil.

13. The transducer of claim 12 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

14. The transducer of claim 10 wherein at least a part of at least one side wall of the coil is tapered outwardly away from the central axis from a position closer to the first end of the coil than the second end of the coil, to a position closer to the second end of the coil than the first end of the coil.

15. The transducer of claim 14 wherein the at least a part of the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

16. The transducer of claim 10 wherein one or both of the upper and lower walls, and at least one side wall of the coil are tapered outwardly away from the central axis from the first end of the coil to the second end of the coil.

17. The transducer of claim 16 wherein the one or both of the upper and lower walls of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

18. The transducer of claim 16 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

19. The transducer of claim 10 wherein at least a part of one or both of the upper and lower walls and at least one side wall of the coil are tapered outwardly away from the central axis from a position closer to the first end of the coil than the second end of the coil, to a position closer to the second end of the coil than the first end of the coil.

20. The transducer of claim 19 wherein the at least a part of one or both of the upper and lower walls of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

21. The transducer of claim 19 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

22. The transducer of claim 10 wherein at least a stretch of at least one side wall of the coil is tapered outwardly from the central axis moving toward the second end the coil, the stretch being located toward the second end of the coil.

23. The transducer of claim 22 wherein the at least a stretch of at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

24. The transducer of claim 10 wherein a stretch of at least a part of one or both of the upper and lower walls and at least one side wall of the coil is tapered outwardly from the central axis moving toward the second end the coil, the stretch being located toward the second end of the coil.

25. The transducer of claim 24 wherein the stretch of at least a part of one or both of the upper and lower walls further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

26. The transducer of claim 24 wherein the at least one side wall of the coil further having a separate raised portion toward the central axis, in relation to the adjacent portion of the wall thereof.

27. A transducer comprising:

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

28. The transducer of claim 27 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets.

29. The transducer of claim 28 wherein the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

30. The transducer of claim 27 wherein at least a stretch of at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets.

31. A transducer comprising:

a pair of spaced permanent magnets at least partially forming a tunnel, the tunnel having a central axis;



a first and second yoke portion;  
at least one shim between one yoke portion and one of the pair of spaced apart magnets;  
a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,  
a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

32. The transducer of claim 31 wherein at least a stretch of the at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets, the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

33. The transducer of claim 31 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets, the tapering being caused by the tapering of the at least a part of one of the first and second yoke portions being tapered along the side of the yoke portion adjacent the one of the pair of magnets.

34. A transducer comprising:

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil, wherein at least one of the upper and the lower tunnel walls of the magnets has a raised portion inwardly toward the central axis toward the first end of the magnets.

35. The transducer of claim 34 wherein the raised portion extends substantially the width of the tunnel.

36. A transducer comprising:

a housing;

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;

an armature having a reed with a central portion which extends through the tunnel, having a stationary end, and having a deflection end, wherein the reed further having a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective

magnets, the armature further having a first leg and a second leg extending along opposed sides of the exterior of the coil and the magnets; and, an at least one spacer for securing the armature to the housing.

37. The transducer of claim 36 wherein the at least one spacer is positioned between the housing and one of the first and second legs of the armature.

38. The transducer of claim 36 wherein the at least one spacer is positioned between the housing and the armature adjacent the stationary end of the reed.

FIG. 1

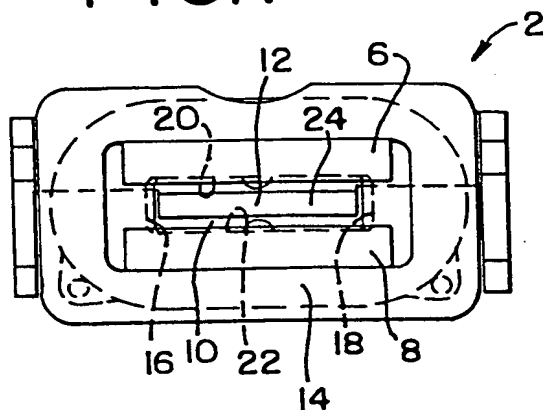


FIG. 2

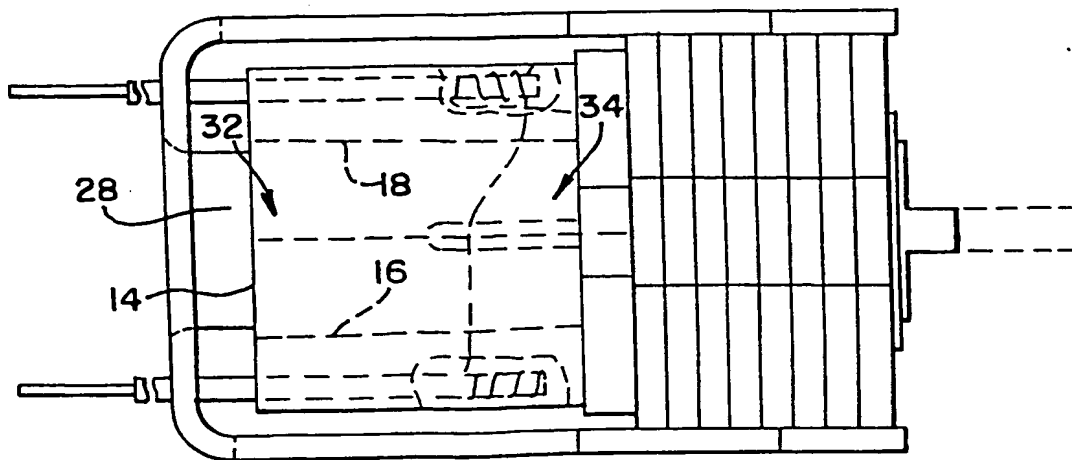


FIG.4

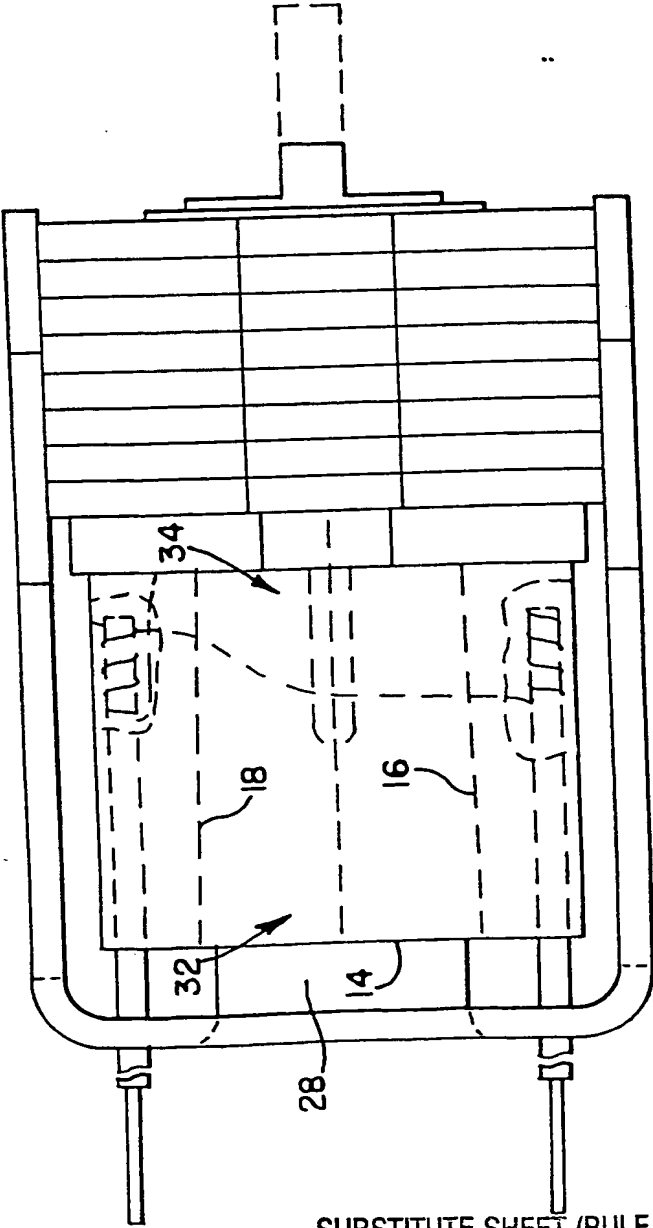


FIG.3

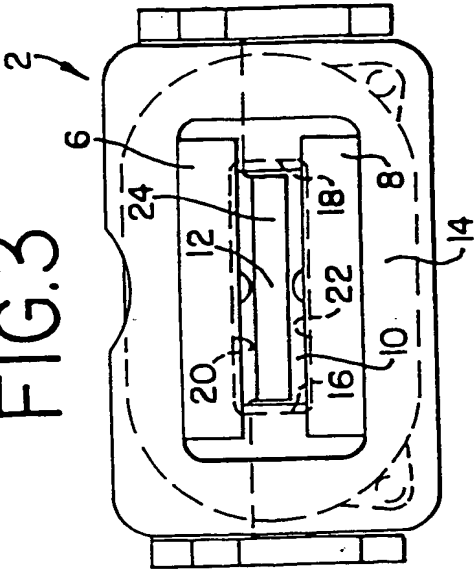


FIG.5

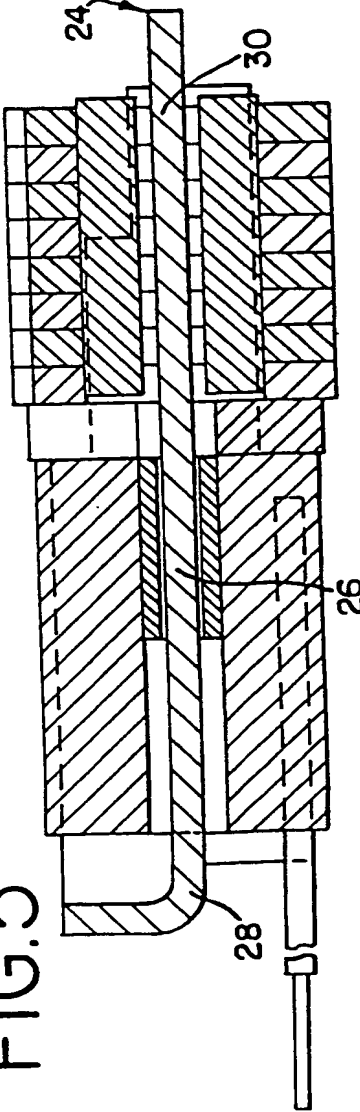


FIG.6

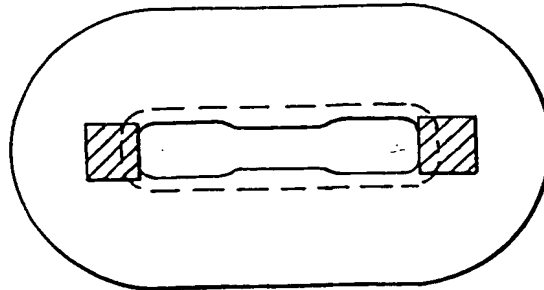


FIG.7

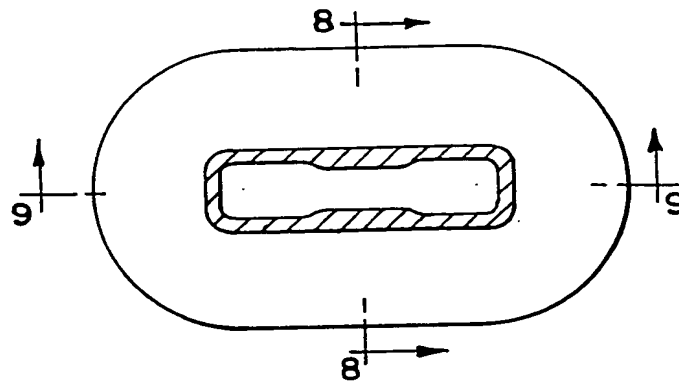


FIG.8

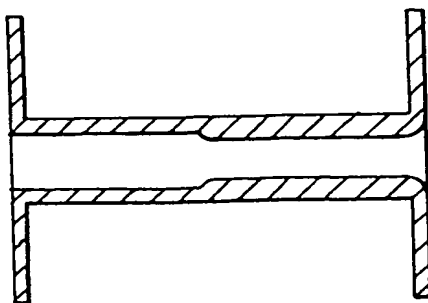


FIG.9

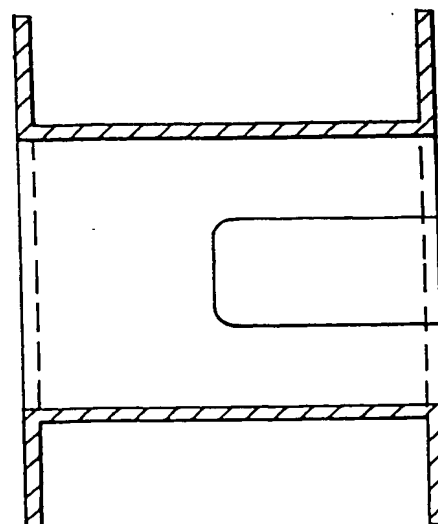


FIG. 10

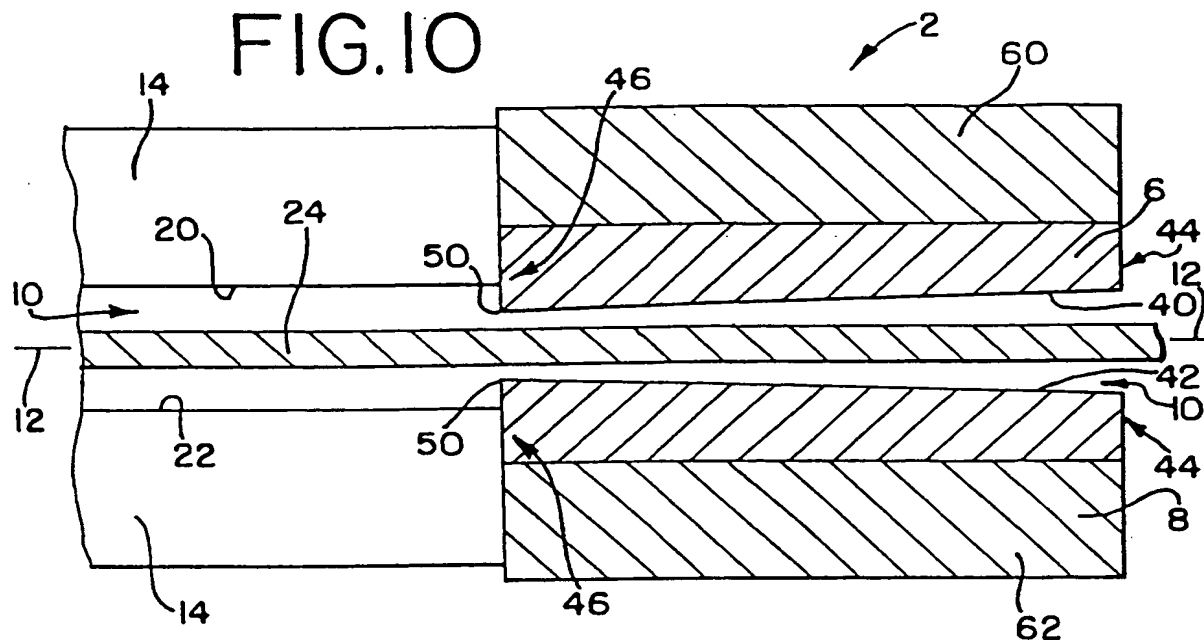


FIG. 12

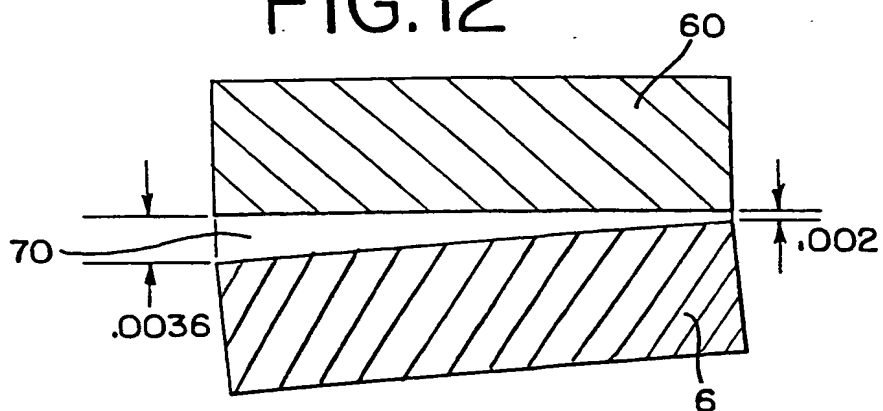


FIG. 11

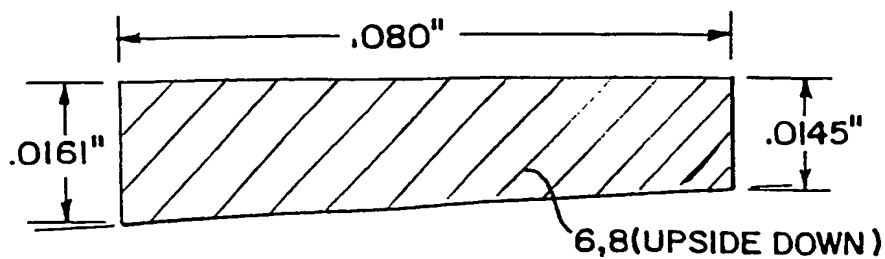


FIG. 13

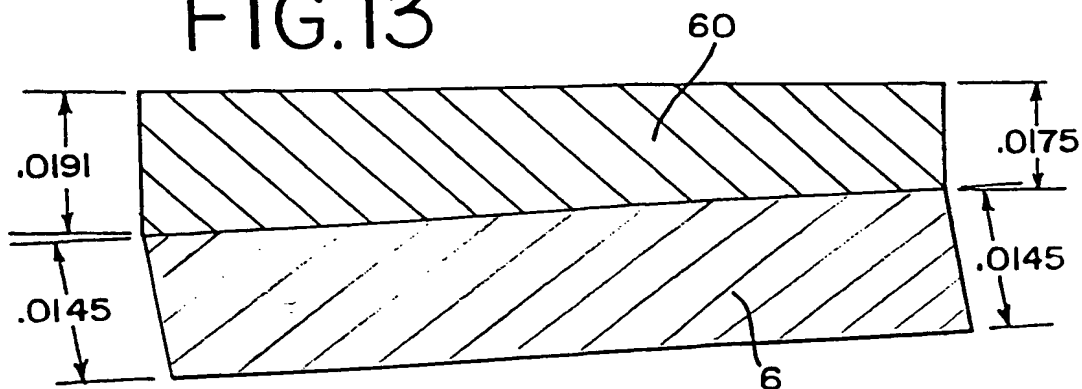


FIG.14

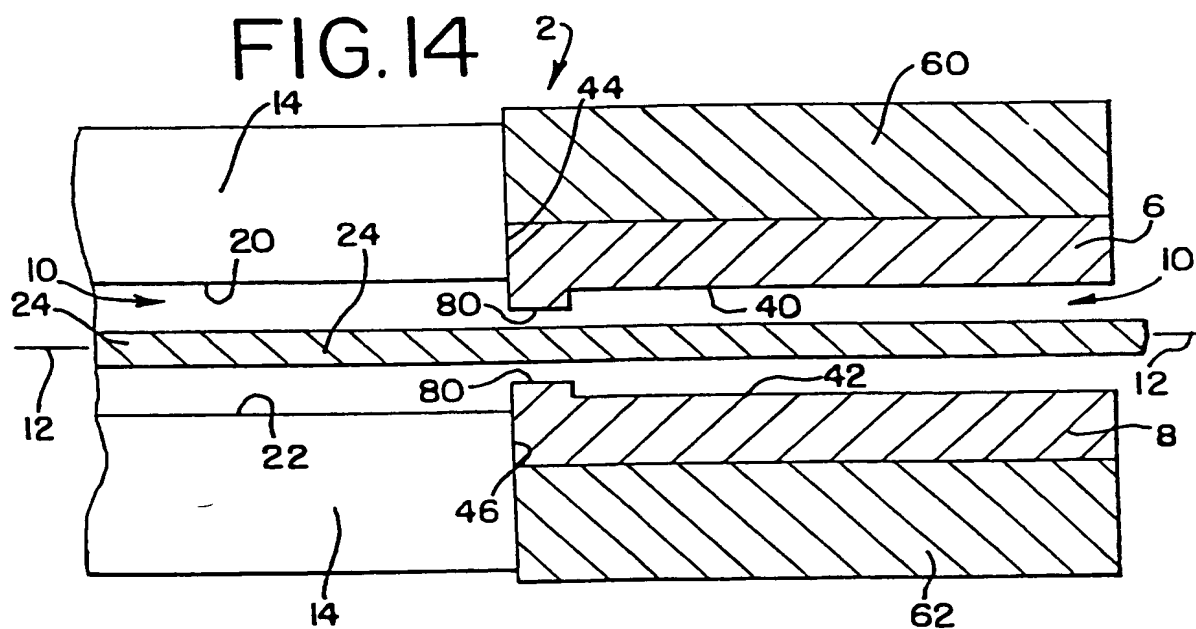


FIG.15

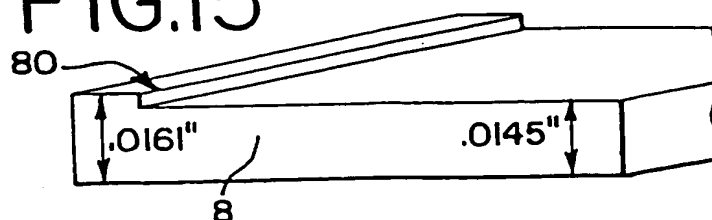


FIG.16

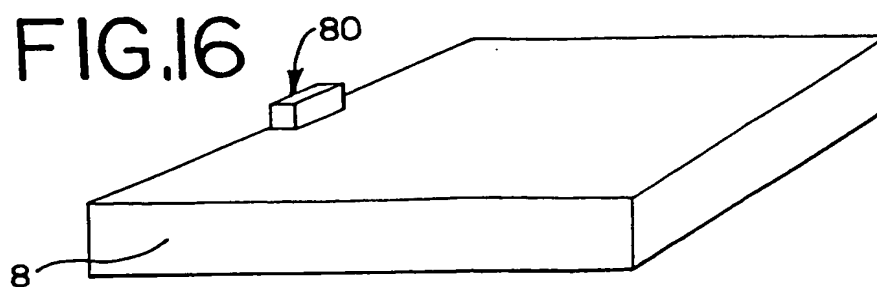




FIG.17

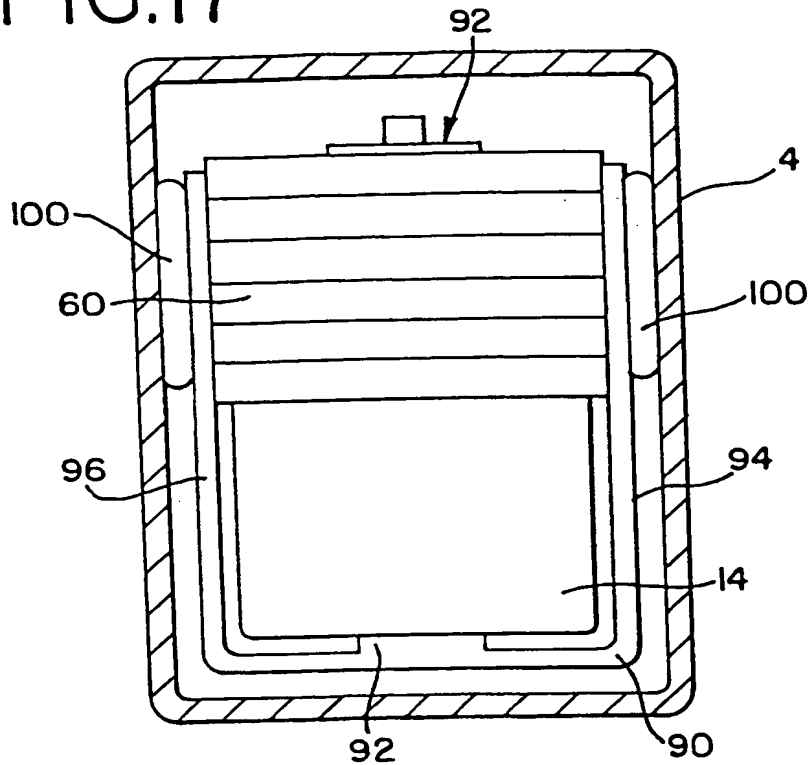
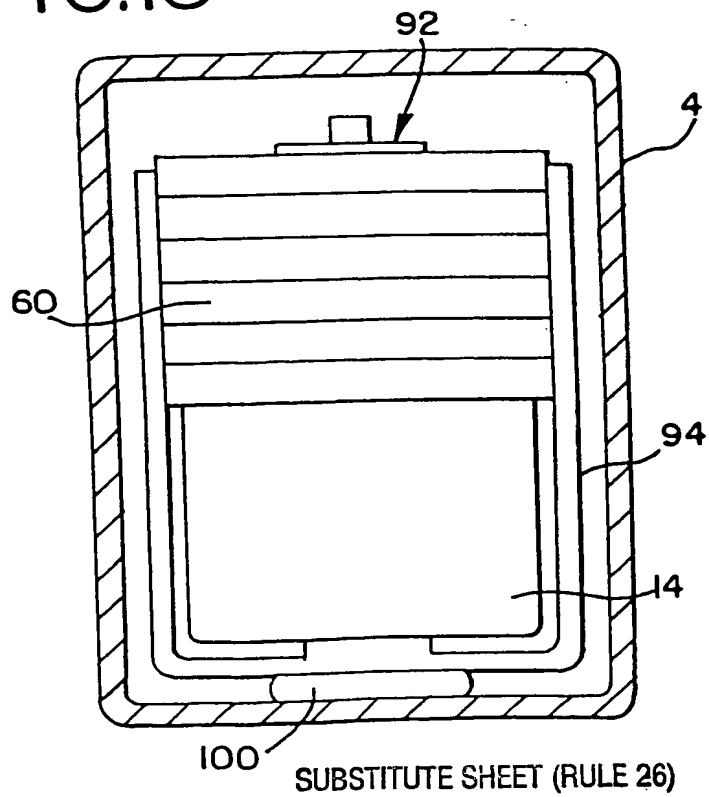


FIG.18



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FIG. 19

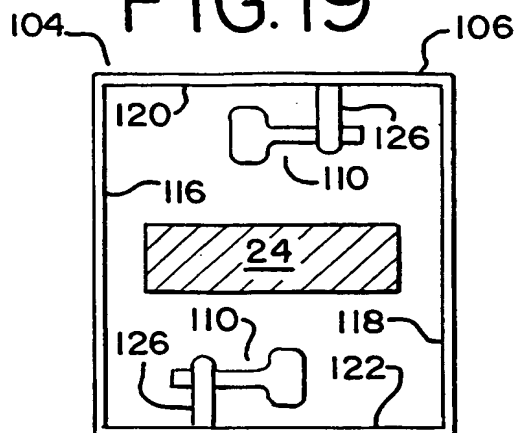


FIG. 20

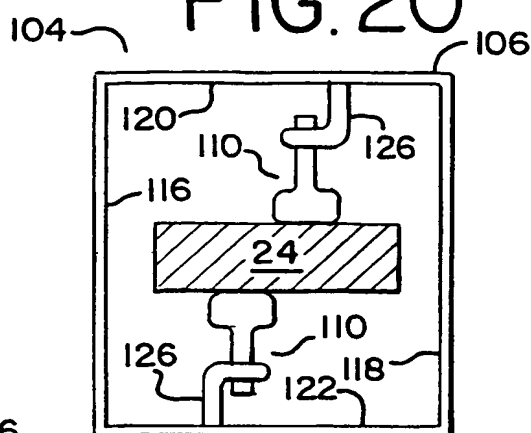


FIG. 21

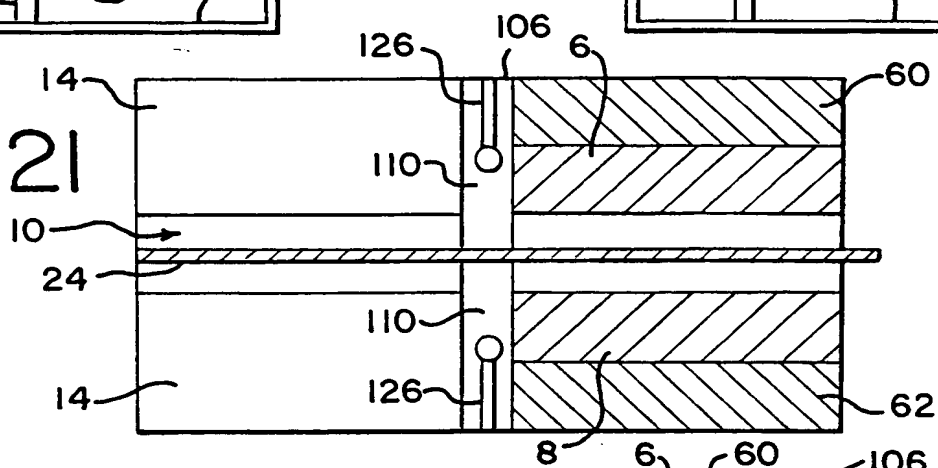


FIG. 22

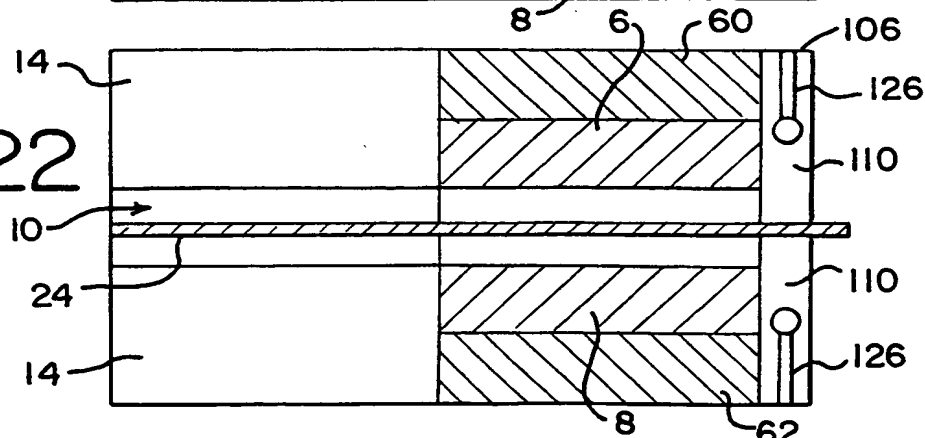
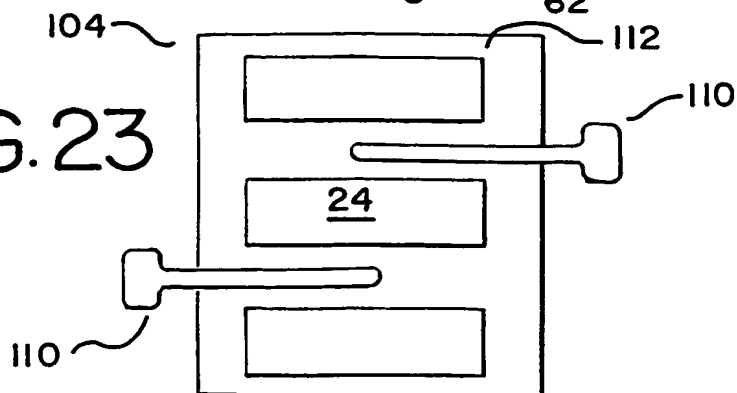


FIG. 23



## PATENT COOPERATION TREATY

PCT

REC'D 31 JAN 2002



WIPO

PCT

## INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

12

Applicant's or agent's file reference 328 P 458		<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/US00/27522	International filing date (day/month/year) 06/10/2000	Priority date (day/month/year) 07/10/1999	
International Patent Classification (IPC) or national classification and IPC H04R11/00			
Applicant KNOWLES ELECTRONICS, LLC et al.			
<p>1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 5 sheets.</p>			
<p>3. This report contains indications relating to the following items:</p> <ul style="list-style-type: none"><li>I <input checked="" type="checkbox"/> Basis of the report</li><li>II <input type="checkbox"/> Priority</li><li>III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</li><li>IV <input checked="" type="checkbox"/> Lack of unity of invention</li><li>V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</li><li>VI <input type="checkbox"/> Certain documents cited</li><li>VII <input type="checkbox"/> Certain defects in the international application</li><li>VIII <input type="checkbox"/> Certain observations on the international application</li></ul>			
Date of submission of the demand 06/04/2001		Date of completion of this report 29.01.2002	
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465		Authorized officer Haertle, M Telephone No. +49 89 2399 8955 	

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/27522

## I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-5,7-9 as originally filed

6 as received on 30/11/2001 with letter of 26/11/2001

**Claims, No.:**

1-30,31 (part),36 (part), as originally filed  
37,38

31 (part),32-35, as received on 30/11/2001 with letter of 26/11/2001  
36 (part)

**Drawings, sheets:**

1/7-3/7,6/7,7/7 as originally filed

4/7,5/7 as received on 30/11/2001 with letter of 26/11/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. **PCT/US00/27522**

- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description,          pages:  
☐ the claims,                Nos.:  
☐ the drawings,            sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☒ restricted the claims.  
☐ paid additional fees.  
☐ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.  
☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.  
☒ the parts relating to claims Nos. 34,35.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;**

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/27522

## **citations and explanations supporting such statement**

### 1. Statement

Novelty (N)	Yes:	Claims	34,35
	No:	Claims	
Inventive step (IS)	Yes:	Claims	34,35
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	34,35
	No:	Claims	

### 2. Citations and explanations **see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/US00/27522

**Item V.2.**

1. Claim 34 : Novelty

The nearest state of the art is D1 : US-A-5 647 013 (SALVAGE RICHARD JAMES ET AL) 8 July 1997 (1997-07-08) cited in the application.

None of the documents cited in the International Search Report nor the nearest state of the art discloses a transducer wherein at least one of the upper and the lower tunnel walls of the magnets has a raised portion inwardly toward the central axis toward the first end of the magnets.

2. Claim 34 : Inventive Step

The combination of features according to Claim 34 cannot be obviously derived from the available state of the art or from the common knowledge of the person skilled in art.

3. Claim 35 :

Claim 35 contains a particular embodiment of the subject-matter of Claim 34 and meets therefore the regulations of Art. 33 (2), 33 (3) PCT.

deflection of the reed 24. Alternatively, the side walls 16, 18 of the coil 14 can be tapered outwardly away from the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Alternatively, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered outwardly away from the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Likewise, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered inwardly toward the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. For the above alternatives or other alternatives, having a coil wall, or any part or stretch thereof, that is tapered, the coil wall can further have a separate raised portion toward the central axis 12, in relation to the adjacent portion of the wall thereof.

Some of the Figures depict dimensions which can be used for the present invention. Other dimensions can be used as well. For the embodiments in Figures 1 through 5, one set of dimensions are as follows: the nominal lateral reed clearance is  $0.0625 \text{ in. (nominal tunnel width)} - 0.0595 \text{ in. (nominal reed width)} = 0.003 \text{ in. (0.0015 in. per side)}$ . Coil tunnel taper is  $0.0045 \text{ in. over } 0.093 \text{ in. length}$ , or about  $2.8^\circ$ . The nominal reed to rib (top or bottom of the coil) is  $0.0111 \text{ in. (nominal rib gap)} - 0.008 \text{ in. (nominal reed thickness)} = 0.0031 \text{ in. (0.0015 in. top / bottom)}$ .

Figure 6 is a front view of a further coil winding bobbin for a transducer 2 of the present invention. Figure 7 is a back view of the coil winding bobbin of Figure 6. Figure 8 is a side view of the coil winding bobbin of Figure 6. Figure 9 is a top view of the coil winding bobbin of Figure 6. These figures show one tapering that can be implemented within the coil winding for the present invention.

*Antoine*



a first and second yoke portion;  
at least one shim between one yoke portion and one of the pair of spaced apart magnets;  
a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,  
a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

32. The transducer of claim 31 wherein at least a stretch of the at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets, the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

33. The transducer of claim 31 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets, the tapering being caused by the tapering of the at least a part of one of the first and second yoke portions being tapered along the side of the yoke portion adjacent the one of the pair of magnets.

34. A transducer comprising:

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,

a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil, wherein at least one of the upper and the lower tunnel walls of the magnets has a raised portion inwardly toward the central axis toward the first end of the magnets.

35. The transducer of claim 34 wherein the raised portion extends substantially the width of the tunnel

36. A transducer comprising:

a housing;

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;

an armature having a reed with a central portion which extends through the tunnel, having a stationary end, and having a deflection end, wherein the reed further having a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective

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FIG. 13

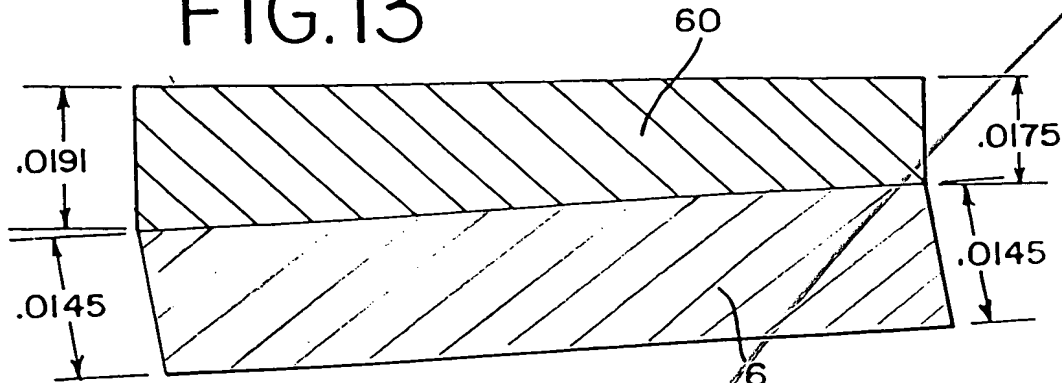


FIG. 14

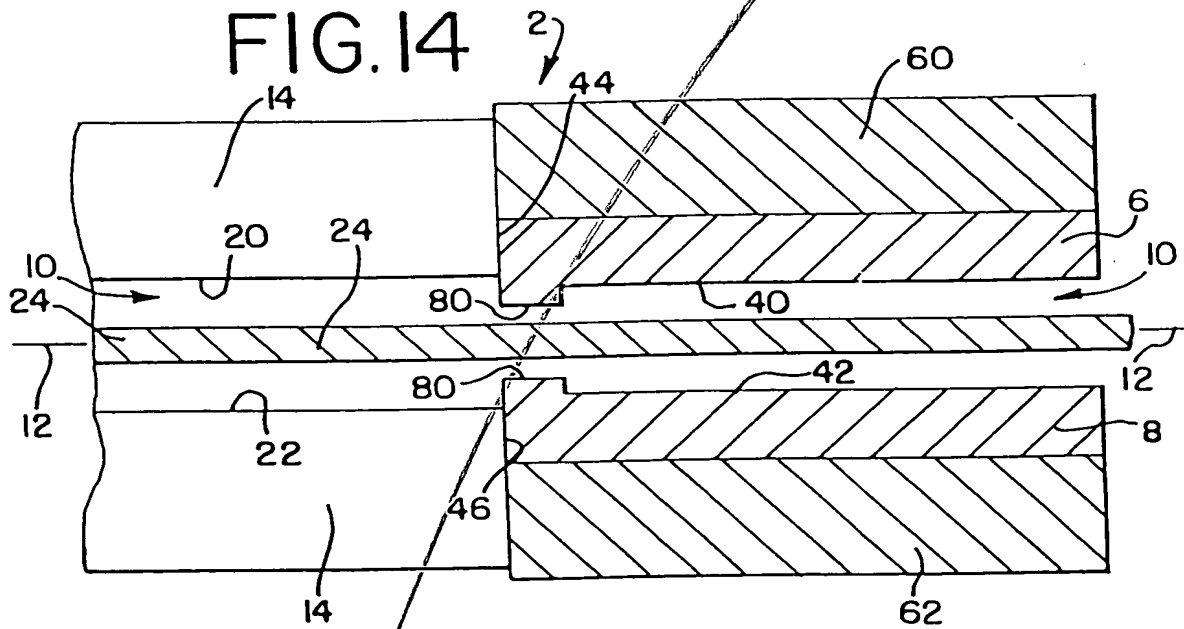


FIG. 15

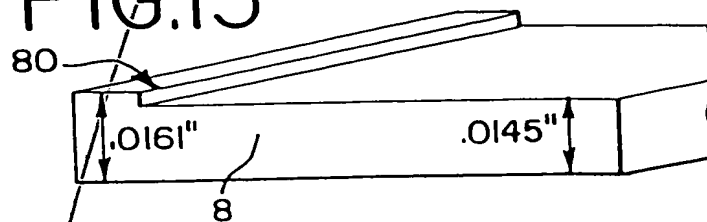
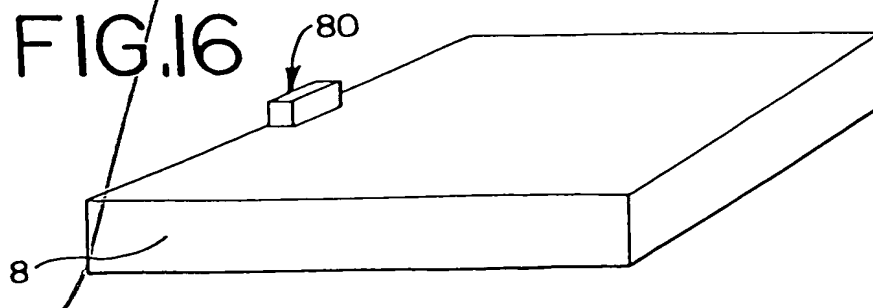


FIG. 16



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FIG. 10

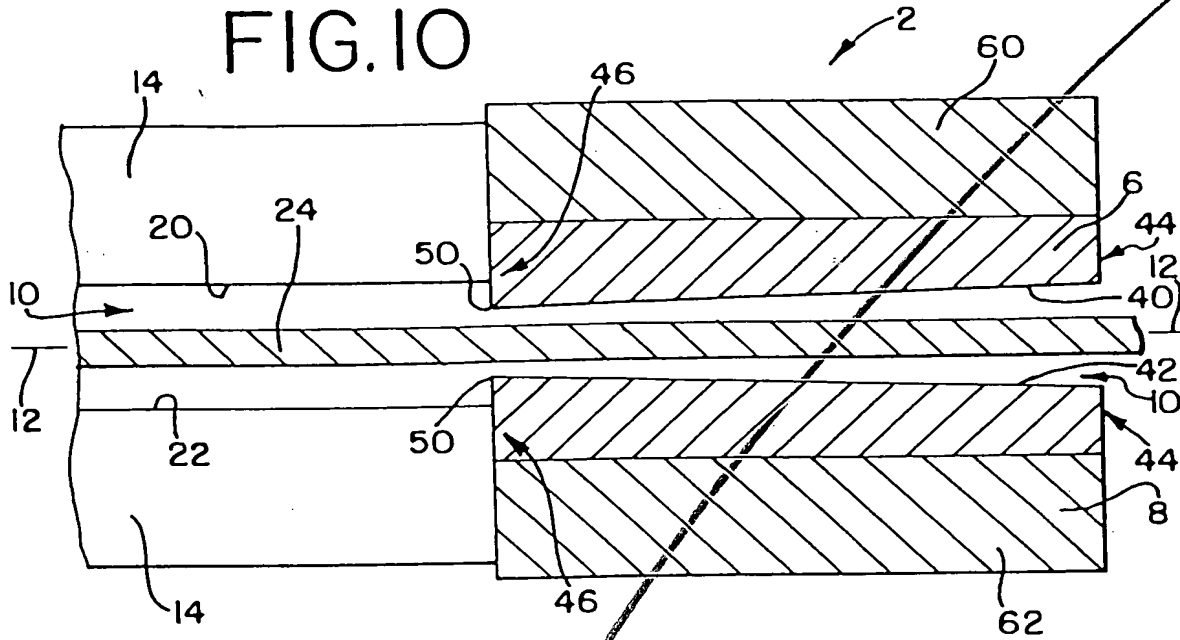


FIG. 12

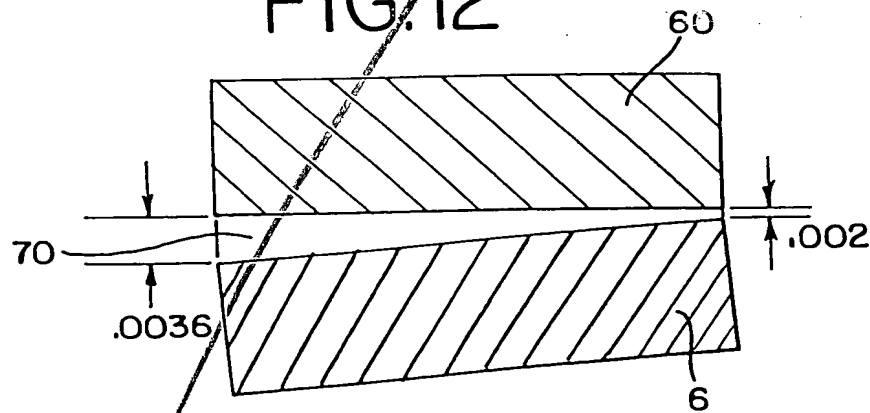


FIG. II

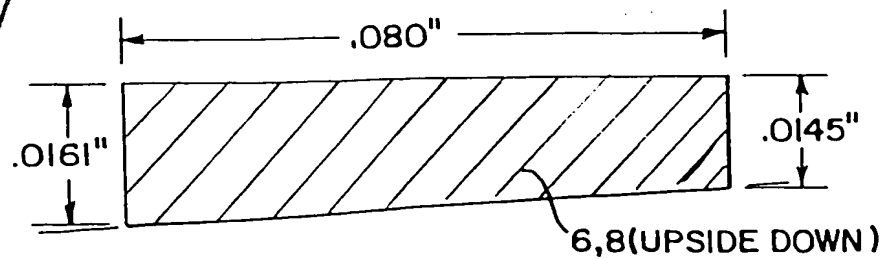


FIG.10

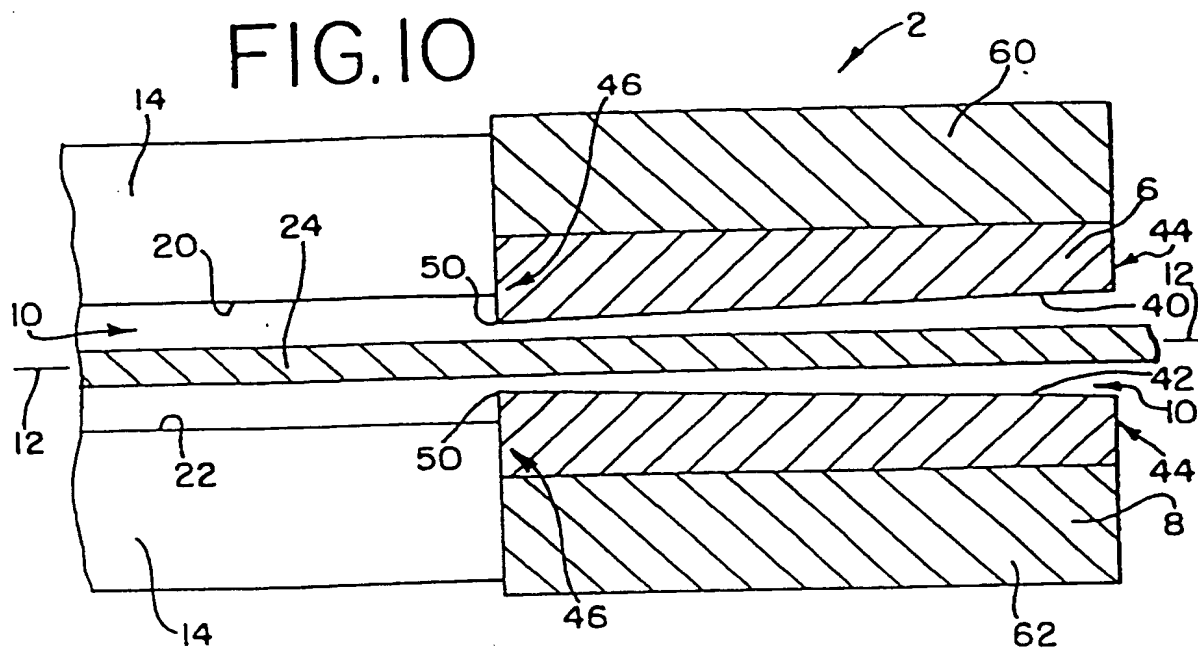


FIG.12

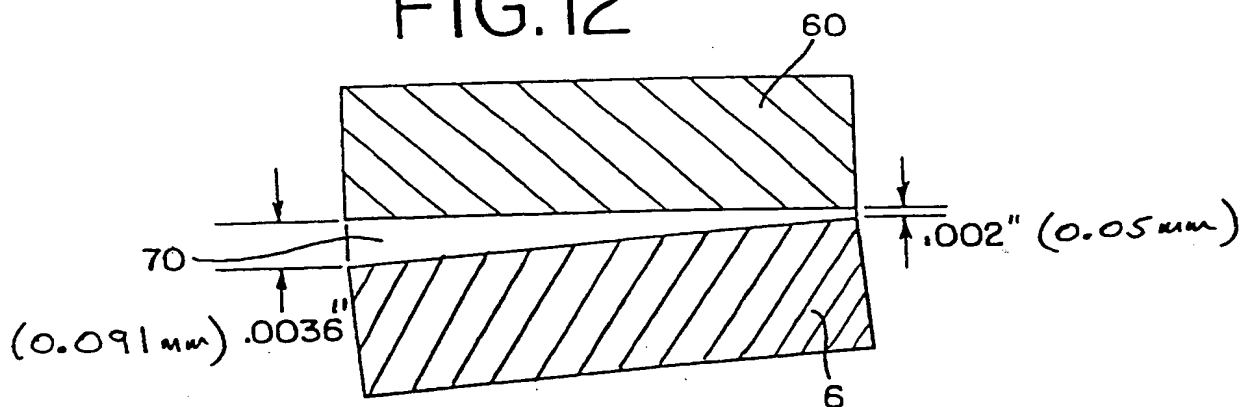


FIG. II

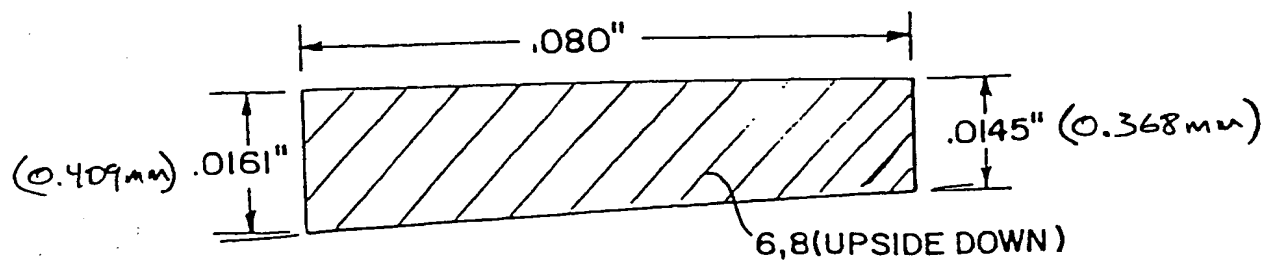


FIG.13

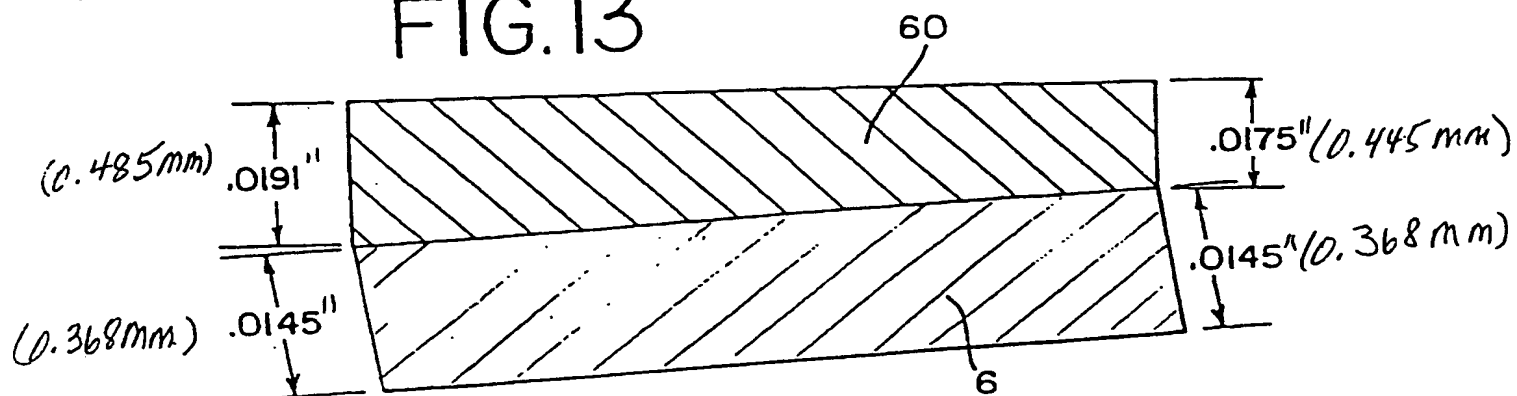


FIG.14

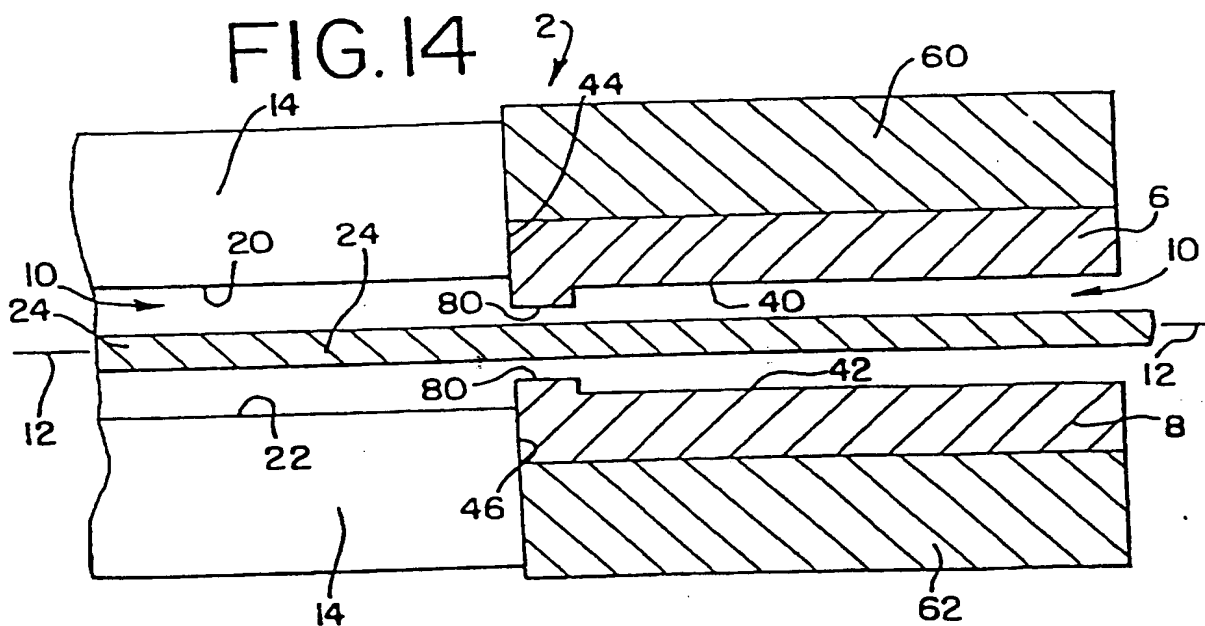


FIG.15

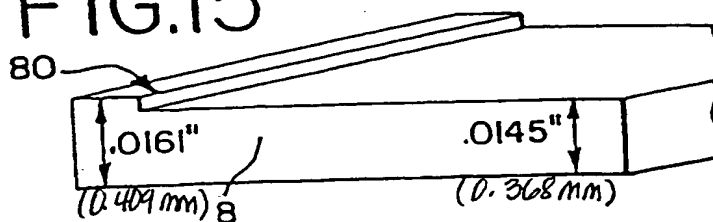
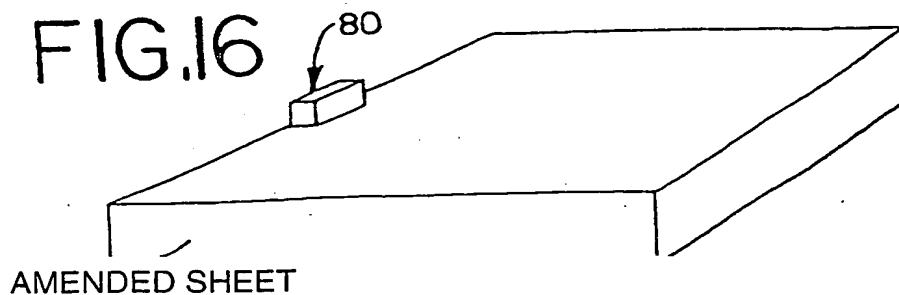


FIG.16



AMENDED SHEET

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau

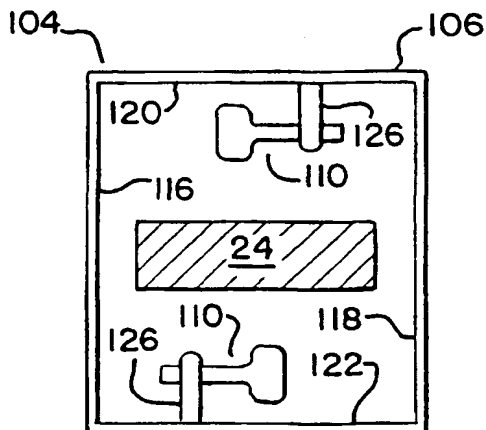


(43) International Publication Date  
12 April 2001 (12.04.2001)

PCT

(10) International Publication Number  
**WO 01/26413 A3**

- (51) International Patent Classification<sup>7</sup>: **H04R 11/00**
- (21) International Application Number: PCT/US00/27522
- (22) International Filing Date: 6 October 2000 (06.10.2000)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:  
60/158,572 7 October 1999 (07.10.1999) US  
60/180,547 7 February 2000 (07.02.2000) US
- (71) Applicant (for all designated States except US):  
**KNOWLES ELECTRONICS, LLC** [US/US]; 1151  
West Maplewood Drive, Itasca, IL 60143 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **TSANGARIS, Paris** [US/US]; 1151 Maplewood Drive, Itasca, IL 60143 (US). **LONGWELL, Thomas, F.** [US/US]; 22639 North 49th Place, Phoenix, AZ 85024 (US). **MILLER, Thomas, E.** [US/US]; 213 South Walnut Avenue, Arlington Heights, IL 60005 (US). **KIRCHHOEFER, Dennis, Ray** [US/US]; 1860 Goss Court, Plainfield, IL 60524 (US). **WARREN, Daniel, M.** [US/US]; 726 Lancaster Lane, Geneva, IL 60134 (US).
- (54) Title: ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SHOCK-WAVES
- (57) Abstract: A transducer comprising a pair of spaced magnets at least partially forming a tunnel having a central axis. A coil having a first and a second side wall and an upper and a lower wall at east partially forms the tunnel. A reed having a central portion extends through the tunnel. The reed has a stationary end, a deflection end, and a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets.
- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.
- (84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).
- Published:  
— with international search report
- (88) Date of publication of the international search report:  
31 January 2002
- For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.



WO 01/26413 A3

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/27522

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H04R11/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 647 013 A (SALVAGE RICHARD JAMES ET AL) 8 July 1997 (1997-07-08) cited in the application	1
X	column 3, line 28 - line 49; figures 8-12	10-27
X	US 3 617 653 A (TIBBETTS GEORGE C ET AL) 2 November 1971 (1971-11-02) column 4, line 50 - line 53; figure 3	27,28,30
X	US 1 871 739 A (A. RINGEL) 16 August 1932 (1932-08-16) page 2, column 1, line 50 - column 2, line 106; figures 1,3	36-38
A	US 4 272 654 A (CARLSON ELMER V) 9 June 1981 (1981-06-09) column 3, line 29 - line 41; figures 1,3	34

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

5 February 2001

Date of mailing of the international search report

05/07/2001

Name and mailing address of the ISA

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Fax: (+31-70) 340-3016

Authorized officer

Anderson, A



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/27522

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US 4272654 A	09-06-1981	NONE	

## PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

## NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner  
US Department of Commerce  
United States Patent and Trademark  
Office, PCT  
2011 South Clark Place Room  
CP2/5C24  
Arlington, VA 22202  
ETATS-UNIS D'AMERIQUE  
in its capacity as elected Office

Date of mailing (day/month/year) 01 June 2001 (01.06.01)	
International application No. PCT/US00/27522	Applicant's or agent's file reference 328 P 458
International filing date (day/month/year) 06 October 2000 (06.10.00)	Priority date (day/month/year) 07 October 1999 (07.10.99)
Applicant TSANGARIS, Paris et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:  
25 April 2001 (25.04.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was  
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Claudio Borton Telephone No.: (41-22) 338.83.38
---	--

In re U.S. National application of: KNOWLES ELECTRONICS, LLC

Inventor(s): Paris TSANGARIS, Thomas F. LONGWELL, Thomas E. MILLER, Dennis Ray  
KIRCHHOEFER and Daniel M. WARREN

For: ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SHOCK-WAVES

**\*\*THIS APPLICATION CLAIMS PRIORITY FROM  
PCT/US00/27522 FILED OCTOBER 6, 2000  
AND  
U.S. SERIAL NO. 60/158,572 FILED OCTOBER 7, 1999  
AND  
U.S. SERIAL NO. 60/180,547 FILED FEBRUARY 7, 2000\*\***

Our Docket No. 328 P 653

ENCLOSED: POSTCARD

CHECK IN THE AMOUNT OF \$1726

2-PAGE TRANSMITTAL LETTER TO U.S. DESIGNATED/ELECTED OFFICE  
CONCERNING A FILING UNDER 35 USC 371

PCT APPLICATION AS FILED

TRANSMITTAL OF INTERNATIONAL SEARCH REPORT

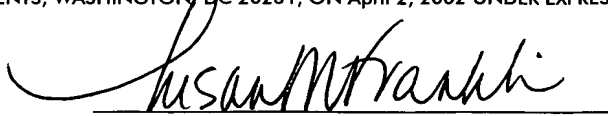
TRANSMITTAL OF INTERNATIONAL PRELIMINARY EXAMINATION REPORT

TO FOLLOW:

EXECUTED DECLARATION/POWER OF ATTORNEY

EXECUTED ASSIGNMENT

I HEREBY CERTIFY THAT THIS PAPER AND THE ABOVE DOCUMENTS ARE BEING DEPOSITED WITH THE U.S. POSTAL SERVICE AS EXPRESS MAIL, POSTAGE PREPAID, IN AN ENVELOPE ADDRESSED TO BOX PCT (U.S. NATIONAL APPLICATION/WITH FEE), COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231, ON April 2, 2002 UNDER EXPRESS MAIL NO. EL929501008US.



**PLEASE ADDRESS ALL FUTURE COMMUNICATIONS TO:**

**THOMAS K. STINE, ESQ.  
WALLENSTEIN & WAGNER  
311 South Wacker Drive - 5300  
Chicago, IL 60606  
(312) 554-3300**

10/089861

JC13 Rec'd PCT/PTO 02 APR 2002

In re PCT application of: KNOWLES ELECTRONICS, LLC

Inventor(s): Paris TSANGARIS, Thomas F. LONGWELL, Thomas E. MILLER, Dennis Ray  
KIRCHHOEFER and Daniel M. WARREN

For: TRANSDUCER WITH RESISTANCE TO SHOCK

**\*\*THIS APPLICATION CLAIMS PRIORITY FROM  
U.S. SERIAL NO. 60/158,572 (FILED 7 OCTOBER 1999)  
AND  
U.S. SERIAL NO. 60/180,547 (FILED 7 FEBRUARY 2000)\*\***

Our Docket No. 328 P 458

ENCLOSED:

POSTCARD

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PCT FEE CALCULATION SHEET

5-PAGE PCT REQUEST FORM

19-PAGE PATENT APPLICATION

7 SHEETS OF INFORMAL DRAWINGS (FIGURES 1-23)

EXECUTED KNOWLES GENERAL POWER OF ATTORNEY

I HEREBY CERTIFY THAT THIS PAPER AND THE ABOVE DOCUMENTS ARE BEING DEPOSITED WITH THE U.S. POSTAL SERVICE AS EXPRESS MAIL, POSTAGE  
PREPAID, IN AN ENVELOPE ADDRESSED TO BOX PCT (PCT APPLICATION/WITH FEE), COMMISSIONER FOR PATENTS, WASHINGTON, DC 20231, ON  
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PLEASE ADDRESS ALL FUTURE COMMUNICATIONS TO:

**MONIQUE A. MORNEAULT, ESQ.  
WALLENSTEIN & WAGNER  
311 South Wacker Drive - 5300  
Chicago, IL 60606  
(312) 554-3300**

107783

Continuation of Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)	
<i>If none of the following sub-boxes is used, this sheet should not be included in the request.</i>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p> <p>LONGWELL, Thomas F. 22639 North 49th Place Phoenix, Arizona 85024 United States of America</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality: US	State <i>(that is, country)</i> of residence: US
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p> <p>MILLER, Thomas E. 213 South Walnut Avenue Arlington Heights, Illinois 60005 United States of America</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality: US	State <i>(that is, country)</i> of residence: US
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p> <p>KIRCHHOEFER, Dennis Ray 1860 Goss Court Plainfield, Illinois 60524 United States of America</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality: US	State <i>(that is, country)</i> of residence: US
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p>Name and address: <i>(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)</i></p> <p>WARREN, Daniel M. 726 Lancaster Lane Geneva, Illinois 60134 United States of America</p>	<p>This person is:</p> <p><input type="checkbox"/> applicant only</p> <p><input checked="" type="checkbox"/> applicant and inventor</p> <p><input type="checkbox"/> inventor only <i>(If this check-box is marked, do not fill in below.)</i></p>
State <i>(that is, country)</i> of nationality: US	State <i>(that is, country)</i> of residence: US
<p>This person is applicant for the purposes of: <input type="checkbox"/> all designated States <input type="checkbox"/> all designated States except the United States of America <input checked="" type="checkbox"/> the United States of America only <input type="checkbox"/> the States indicated in the Supplemental Box</p>	
<p><input type="checkbox"/> Further applicants and/or (further) inventors are indicated on another continuation sheet.</p>	

# PCT

## FEE CALCULATION SHEET Annex to the Request

For receiving Office use only

International application No.

Applicant's or agent's  
file reference

328 P 458

Date stamp of the receiving Office

Applicant

KNOWLES ELECTRONICS, LLC

### CALCULATION OF PRESCRIBED FEES

1. TRANSMITTAL FEE ..... 240.00 T

2. SEARCH FEE ..... 925.00 S

International search to be carried out by EP

(If two or more International Searching Authorities are competent in relation to the international application, indicate the name of the Authority which is chosen to carry out the international search.)

3. INTERNATIONAL FEE

#### Basic Fee

The international application contains 31 sheets.

first 30 sheets ..... 427.00 b<sub>1</sub>

1 x \$10.00 = 10.00 b<sub>2</sub>  
remaining sheets additional amount

Add amounts entered at b<sub>1</sub> and b<sub>2</sub> and enter total at B ..... 437.00 B

#### Designation Fees

The international application contains all designations.

8 x 92.00 = 736.00 D

number of designation fees amount of designation fee payable (maximum 10)

Add amounts entered at B and D and enter total at I ..... 1,173.00 I

(Applicants from certain States are entitled to a reduction of 75% of the international fee. Where the applicant is (or all applicants are) so entitled,

4. FEE FOR PRIORITY DOCUMENT (if applicable) ..... 30.00 P

5. TOTAL FEES PAYABLE

Add amounts entered at T, S, I and P, and enter total in the TOTAL box

2,368.00

TOTAL

☐ The designation fees are not paid at this time.

### MODE OF PAYMENT

☐ authorization to charge  
deposit account (see below)

☐ bank draft

☐ coupons

☒ cheque

☐ cash

☐ other (specify):

☐ postal money order

☐ revenue stamps

### DEPOSIT ACCOUNT AUTHORIZATION (this mode of payment may not be available at all receiving Offices)

The RO/ US ☐ is hereby authorized to charge the total fees indicated above to my deposit account.

☒ (this check-box may be marked only if the conditions for deposit accounts of the receiving Office so permit) is hereby authorized to charge any deficiency or credit any overpayment in the total fees indicated above to my deposit account.

☐ is hereby authorized to charge the fee for preparation and transmittal of the priority document to the International Bureau of WIPO to my deposit account.

23-0280

6 October 2000

Deposit Account Number

Date (day/month/year)

Signature

*Monique A. Monseau*

# PCT

## REQUEST

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

For receiving Office use only

International Application No.

International Filing Date

Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference  
(if desired) (12 characters maximum) 328 P 458

### Box No. I TITLE OF INVENTION

TRANSDUCER WITH RESISTANCE TO SHOCK

### Box No. II APPLICANT

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

KNOWLES ELECTRONICS, LLC  
1151 West Maplewood Drive  
Itasca, Illinois 60143

☐ This person is also inventor.

Telephone No.  
1-630-250-5100

Facsimile No.  
1-630-250-0575

Teleprinter No.

State (that is, country) of nationality:  
US

State (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☒ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

### Box No. III FURTHER APPLICANT(S) AND/OR (FURTHER) INVENTOR(S)

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)

TSANGARIS, Paris  
1151 Maplewood Drive  
Itasca, Illinois 60143  
United States of America

This person is:

☐ applicant only  
☒ applicant and inventor

☐ inventor only (If this check-box is marked, do not fill in below.)

State (that is, country) of nationality:  
US

State (that is, country) of residence:  
US

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

### Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:

☒ agent ☐ common representative

Name and address: (Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country.)

MORNEAULT, Monique A.  
WALLENSTEIN & WAGNER, LTD.  
311 South Wacker Drive - 5300  
Chicago, Illinois 60606  
United States of America

Telephone No.  
1-312-554-3300

Facsimile No.  
1-312-554-3301

Teleprinter No.

☐ Address for correspondence: Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

**Box No.V DESIGNATION OF STATES**

The following designations are hereby made under Rule 4.9(a) (mark the applicable check-boxes; at least one must be marked):

**Regional Patent**

- ☒ **AP** ARIPO Patent: GH Ghana, GM Gambia, KE Kenya, LS Lesotho, MW Malawi, MZ Mozambique, SD Sudan, SL Sierra Leone, SZ Swaziland, TZ United Republic of Tanzania, UG Uganda, ZW Zimbabwe, and any other State which is a Contracting State of the Harare Protocol and of the PCT
- ☒ **EA** Eurasian Patent: AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakhstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT
- ☒ **EP** European Patent: AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☒ **OA** OAPI Patent: BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, GW Guinea-Bissau, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT (if other kind of protection or treatment desired, specify on dotted line)

**National Patent (if other kind of protection or treatment desired, specify on dotted line):**

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> <b>AE</b> United Arab Emirates                  | <input checked="" type="checkbox"/> <b>LC</b> Saint Lucia                               |
| <input checked="" type="checkbox"/> <b>AG</b> Antigua and Barbuda                   | <input checked="" type="checkbox"/> <b>LK</b> Sri Lanka                                 |
| <input checked="" type="checkbox"/> <b>AL</b> Albania                               | <input checked="" type="checkbox"/> <b>LR</b> Liberia                                   |
| <input checked="" type="checkbox"/> <b>AM</b> Armenia                               | <input checked="" type="checkbox"/> <b>LS</b> Lesotho                                   |
| <input checked="" type="checkbox"/> <b>AT</b> Austria                               | <input checked="" type="checkbox"/> <b>LT</b> Lithuania                                 |
| <input checked="" type="checkbox"/> <b>AU</b> Australia                             | <input checked="" type="checkbox"/> <b>LU</b> Luxembourg                                |
| <input checked="" type="checkbox"/> <b>AZ</b> Azerbaijan                            | <input checked="" type="checkbox"/> <b>LV</b> Latvia                                    |
| <input checked="" type="checkbox"/> <b>BA</b> Bosnia and Herzegovina                | <input checked="" type="checkbox"/> <b>MA</b> Morocco                                   |
| <input checked="" type="checkbox"/> <b>BB</b> Barbados                              | <input checked="" type="checkbox"/> <b>MD</b> Republic of Moldova                       |
| <input checked="" type="checkbox"/> <b>BG</b> Bulgaria                              | <input checked="" type="checkbox"/> <b>MG</b> Madagascar                                |
| <input checked="" type="checkbox"/> <b>BR</b> Brazil                                | <input checked="" type="checkbox"/> <b>MK</b> The former Yugoslav Republic of Macedonia |
| <input checked="" type="checkbox"/> <b>BY</b> Belarus                               | <input checked="" type="checkbox"/> <b>MN</b> Mongolia                                  |
| <input checked="" type="checkbox"/> <b>BZ</b> Belize                                | <input checked="" type="checkbox"/> <b>MW</b> Malawi                                    |
| <input checked="" type="checkbox"/> <b>CA</b> Canada                                | <input checked="" type="checkbox"/> <b>MX</b> Mexico                                    |
| <input checked="" type="checkbox"/> <b>CH and LI</b> Switzerland and Liechtenstein  | <input checked="" type="checkbox"/> <b>MZ</b> Mozambique                                |
| <input checked="" type="checkbox"/> <b>CN</b> China                                 | <input checked="" type="checkbox"/> <b>NO</b> Norway                                    |
| <input checked="" type="checkbox"/> <b>CR</b> Costa Rica                            | <input checked="" type="checkbox"/> <b>NZ</b> New Zealand                               |
| <input checked="" type="checkbox"/> <b>CU</b> Cuba                                  | <input checked="" type="checkbox"/> <b>PL</b> Poland                                    |
| <input checked="" type="checkbox"/> <b>CZ</b> Czech Republic                        | <input checked="" type="checkbox"/> <b>PT</b> Portugal                                  |
| <input checked="" type="checkbox"/> <b>DE</b> Germany                               | <input checked="" type="checkbox"/> <b>RO</b> Romania                                   |
| <input checked="" type="checkbox"/> <b>DK</b> Denmark                               | <input checked="" type="checkbox"/> <b>RU</b> Russian Federation                        |
| <input checked="" type="checkbox"/> <b>DM</b> Dominica                              | <input checked="" type="checkbox"/> <b>SD</b> Sudan                                     |
| <input checked="" type="checkbox"/> <b>DZ</b> Algeria                               | <input checked="" type="checkbox"/> <b>SE</b> Sweden                                    |
| <input checked="" type="checkbox"/> <b>EE</b> Estonia                               | <input checked="" type="checkbox"/> <b>SG</b> Singapore                                 |
| <input checked="" type="checkbox"/> <b>ES</b> Spain                                 | <input checked="" type="checkbox"/> <b>SI</b> Slovenia                                  |
| <input checked="" type="checkbox"/> <b>FI</b> Finland                               | <input checked="" type="checkbox"/> <b>SK</b> Slovakia                                  |
| <input checked="" type="checkbox"/> <b>GB</b> United Kingdom                        | <input checked="" type="checkbox"/> <b>SL</b> Sierra Leone                              |
| <input checked="" type="checkbox"/> <b>GD</b> Grenada                               | <input checked="" type="checkbox"/> <b>TJ</b> Tajikistan                                |
| <input checked="" type="checkbox"/> <b>GE</b> Georgia                               | <input checked="" type="checkbox"/> <b>TM</b> Turkmenistan                              |
| <input checked="" type="checkbox"/> <b>GH</b> Ghana                                 | <input checked="" type="checkbox"/> <b>TR</b> Turkey                                    |
| <input checked="" type="checkbox"/> <b>GM</b> Gambia                                | <input checked="" type="checkbox"/> <b>TT</b> Trinidad and Tobago                       |
| <input checked="" type="checkbox"/> <b>HR</b> Croatia                               | <input checked="" type="checkbox"/> <b>TZ</b> United Republic of Tanzania               |
| <input checked="" type="checkbox"/> <b>HU</b> Hungary                               | <input checked="" type="checkbox"/> <b>UA</b> Ukraine                                   |
| <input checked="" type="checkbox"/> <b>ID</b> Indonesia                             | <input checked="" type="checkbox"/> <b>UG</b> Uganda                                    |
| <input checked="" type="checkbox"/> <b>IL</b> Israel                                | <input checked="" type="checkbox"/> <b>US</b> United States of America (Utility)        |
| <input checked="" type="checkbox"/> <b>IN</b> India                                 | <input checked="" type="checkbox"/> <b>UZ</b> Uzbekistan                                |
| <input checked="" type="checkbox"/> <b>IS</b> Iceland                               | <input checked="" type="checkbox"/> <b>VN</b> Viet Nam                                  |
| <input checked="" type="checkbox"/> <b>JP</b> Japan                                 | <input checked="" type="checkbox"/> <b>YU</b> Yugoslavia                                |
| <input checked="" type="checkbox"/> <b>KE</b> Kenya                                 | <input checked="" type="checkbox"/> <b>ZA</b> South Africa                              |
| <input checked="" type="checkbox"/> <b>KG</b> Kyrgyzstan                            | <input checked="" type="checkbox"/> <b>ZW</b> Zimbabwe                                  |
| <input checked="" type="checkbox"/> <b>KP</b> Democratic People's Republic of Korea |   |
| <input checked="" type="checkbox"/> <b>KR</b> Republic of Korea                     |   |
| <input checked="" type="checkbox"/> <b>KZ</b> Kazakhstan                            |   |

Check-box reserved for designating States which have become party to the PCT after issuance of this sheet:



**Precautionary Designation Statement:** In addition to the designations made above, the applicant also makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit. (Confirmation (including fees) must reach the receiving Office within the 15-month time limit.)



**Supplemental Box** *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." indicate the number of the Box and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

- (i) if more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;
- (ii) if, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;
- (iii) if, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of the United States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;
- (iv) if, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;
- (v) if, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;
- (vi) if, in Box No. VI, there are more than three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI;
- (vii) if, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No. VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property or one Member of the World Trade Organization for which that earlier application was filed.

2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded.

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below.

BISHOP, Edward L.  
 CHRISTUS, Daniel N.  
 CLANCY, Christopher S.  
 DIEHL, Robert W.  
 FUCHS, Joseph A.  
 GARGANO, Jeffrey R.  
 GRZYLO, Matthew J.  
 HAWKINS, Brent A.  
 HIMELHOCH, Richard C.  
 KINSELLA, Joseph M.  
 KLOBUCHAR, Peter M.  
 KUCZMA, Linda A.  
 LAKE, Micheal D.  
 LENZ, William J.  
 MURAFF, James P.  
 NEWMARK, Jordan A.  
 NOLTE, Nelson D.  
 NUTTER, Michael K.  
 NYKAZA, Paul J.  
 RADEMAKER, Bradley F.  
 SIAVELIS, Peter M.  
 STEIN, Roger H.  
 STINE, Thomas K.

WALLENSTEIN & WAGNER, LTD., 311 South Wacker Drive - 5300, Chicago, Illinois 60606, 312-554-3300.

<b>Box No. VI PRIORITY CLAIM</b>		<input type="checkbox"/> Further priority claims are indicated in the Supplemental Box.		
Filing date of earlier application (day/month/year)	Number of earlier application	Where earlier application is:		
		national application: country	regional application: regional Office	international application: receiving Office
item (1) 7 October 1999	60/158,572	US		
item (2) 7 February 2000	60/180,547	US		
item (3)				
<input checked="" type="checkbox"/> The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) (only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office) identified above as item(s): <b>(1) and (2)</b>				
<small>* Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii)). See Supplemental Box.</small>				
<b>Box No. VII INTERNATIONAL SEARCHING AUTHORITY</b>				
<b>Choice of International Searching Authority (ISA)</b> <small>(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):</small> <b>ISA / EPO</b>		<b>Request to use results of earlier search; reference to that search</b> (if an earlier search has been carried out by or requested from the International Searching Authority): Date (day/month/year)      Number      Country (or regional Office)		
<b>Box No. VIII CHECK LIST; LANGUAGE OF FILING</b>				
This international application contains the following number of sheets: request : 5 description (excluding sequence listing part) : 9 claims : 9 abstract : 1 drawings : 7 sequence listing part of description : 0 <b>Total number of sheets : 31</b>		This international application is accompanied by the item(s) marked below: 1. <input checked="" type="checkbox"/> fee calculation sheet 2. <input type="checkbox"/> separate signed power of attorney 3. <input checked="" type="checkbox"/> copy of general power of attorney, reference number, if any: 4. <input type="checkbox"/> statement explaining lack of signature 5. <input type="checkbox"/> priority document(s) identified in Box No. VI as item(s): 6. <input type="checkbox"/> translation of international application into (language): 7. <input type="checkbox"/> separate indications concerning deposited microorganism or other biological material 8. <input type="checkbox"/> nucleotide and/or amino acid sequence listing in computer readable form 9. <input checked="" type="checkbox"/> other (specify): Exp Mail cover sheet; Check for filing fee; postcard		
Figure of the drawings which should accompany the abstract: <b>1</b>		Language of filing of the international application: <b>English</b>		
<b>Box No. IX SIGNATURE OF APPLICANT OR AGENT</b>				
<small>Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).</small>				
By <u>Monique A. Morneau</u> Dated: 6 October 2000 Monique A. Morneau				

For receiving Office use only	
1. Date of actual receipt of the purported international application: 3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application: 4. Date of timely receipt of the required corrections under PCT Article 11(2): 5. International Searching Authority (if two or more are competent): <b>ISA /</b>	2. Drawings: <input type="checkbox"/> received: <input type="checkbox"/> not received: 6. <input type="checkbox"/> Transmittal of search copy delayed until search fee is paid.

For International Bureau use only	
Date of receipt of the record copy by the International Bureau:	

## PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>328 P 458</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/US 00/ 27522</b>	International filing date (day/month/year) <b>06/10/2000</b>	(Earliest) Priority Date (day/month/year) <b>07/10/1999</b>
Applicant  <b>KNOWLES ELECTRONICS, LLC</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

## 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SHOCK-WAVES**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

19

☐ None of the figures.

# PATENT COOPERATION TREATY

From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

MORNEAULT, Monique A.  
WALLENSTEIN & WAGNER, LTD.  
311 South Wacker Drive - 5300  
CHICAGO, ILLINOIS 60606  
ETATS-UNIS D'AMERIQUE

## PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year) 29.01.2002

Applicant's or agent's file reference  
328 P 458

### IMPORTANT NOTIFICATION

International application No.  
PCT/US00/27522

International filing date (day/month/year)  
06/10/2000

Priority date (day/month/year)  
07/10/1999

Applicant  
KNOWLES ELECTRONICS, LLC et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

#### 4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

**RECEIVED**  
**TO DOCKETING** 12 2002  
**WALLENSTEIN & WAGNER**

Name and mailing address of the IPEA/

 European Patent Office  
D-80298 Munich  
Tel. +49 89 2399 - 0 Tx: 523656 epmu d  
Fax: +49 89 2399 - 4465

Authorized officer

Teschauer, B  
Tel. +49 89 2399-8231



10702

*Ch. M. M. Clnt*

# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>328 P 458</b>	<b>FOR FURTHER ACTION</b> See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. <b>PCT/US00/27522</b>	International filing date ( <i>day/month/year</i> ) <b>06/10/2000</b>	Priority date ( <i>day/month/year</i> ) <b>07/10/1999</b>
International Patent Classification (IPC) or national classification and IPC <b>H04R11/00</b>		
Applicant <b>KNOWLES ELECTRONICS, LLC et al.</b>		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
  
2. This REPORT consists of a total of 5 sheets, including this cover sheet.
 

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I    ☒ Basis of the report
- II   ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV   ☒ Lack of unity of invention
- V    ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI   ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand  <b>06/04/2001</b>	Date of completion of this report  <b>29.01.2002</b>
Name and mailing address of the international preliminary examining authority:  <div style="display: flex; align-items: center;"> <div>             European Patent Office              D-80298 Munich              Tel. +49 89 2399 - 0 Tx: 523656 epmu d              Fax: +49 89 2399 - 4465           </div> </div>	Authorized officer  <b>Haertle, M</b>  Telephone No. +49 89 2399 8955



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US00/27522

**I. Basis of the report**

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

**Description, pages:**

1-5,7-9	as originally filed			
6	as received on	30/11/2001	with letter of	26/11/2001

**Claims, No.:**

1-30,31 (part),36 (part), 37,38	as originally filed			
31 (part),32-35, 36 (part)	as received on	30/11/2001	with letter of	26/11/2001

**Drawings, sheets:**

1/7-3/7,6/7,7/7	as originally filed			
4/7,5/7	as received on	30/11/2001	with letter of	26/11/2001

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US00/27522

- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description,      pages:  
☐ the claims,      Nos.:  
☐ the drawings,      sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

*(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)*

6. Additional observations, if necessary:

**IV. Lack of unity of invention**

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☒ restricted the claims.  
☐ paid additional fees.  
☐ paid additional fees under protest.  
☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with.  
☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.  
☒ the parts relating to claims Nos. 34,35.

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability;**

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US00/27522

## **citations and explanations supporting such statement**

### **1. Statement**

Novelty (N)	Yes:	Claims	34,35
	No:	Claims	
Inventive step (IS)	Yes:	Claims	34,35
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	34,35
	No:	Claims	

### **2. Citations and explanations see separate sheet**



**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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International application No. PCT/US00/27522

**Item V.2.**

**1. Claim 34 : Novelty**

The nearest state of the art is D1 : US-A-5 647 013 (SALVAGE RICHARD JAMES ET AL) 8 July 1997 (1997-07-08) cited in the application.

None of the documents cited in the International Search Report nor the nearest state of the art discloses a transducer wherein at least one of the upper and the lower tunnel walls of the magnets has a raised portion inwardly toward the central axis toward the first end of the magnets.

**2. Claim 34 : Inventive Step**

The combination of features according to Claim 34 cannot be obviously derived from the available state of the art or from the common knowledge of the person skilled in art.

**3. Claim 35 :**

Claim 35 contains a particular embodiment of the subject-matter of Claim 34 and meets therefore the regulations of Art. 33 (2), 33 (3) PCT.

deflection of the reed 24. Alternatively, the side walls 16, 18 of the coil 14 can be tapered outwardly away from the central axis 12 from the first end 32 of the coil 14 to the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24.

Alternatively, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered outwardly away from the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. Likewise, at least a part or stretch of at least one side wall 16, 18 of the coil can be tapered inwardly toward the central axis 12, moving toward the second end 34 of the coil 14, to prevent or reduce unwanted horizontal deflection of the reed 24. For the above alternatives or other alternatives, having a coil wall, or any part or stretch thereof, that is tapered, the coil wall can further have a separate raised portion toward the central axis 12, in relation to the adjacent portion of the wall thereof.

Some of the Figures depict dimensions which can be used for the present invention. Other dimensions can be used as well. For the embodiments in Figures 1 through 5, one set of dimensions are as follows: the nominal lateral reed clearance is (.0625"/ 1.59mm) (nominal tunnel width) - (.0595"/1.51mm)(nominal reed width) = (.003"/.076mm) or (.0015"/.038mm) per side. Coil tunnel taper is (.0045"/.11mm) over (.093"/2.4mm) length, or about 2.8°. The nominal reed to rib (top or bottom of the coil) is (.0111"/.282mm) (nominal rib gap) - (.008"/.2mm) (nominal reed thickness) = (.0031"/.079mm), or (.0015"/.039mm) top / bottom.

Figure 6 is a front view of a further coil winding bobbin for a transducer 2 of the present invention. Figure 7 is a back view of the coil winding bobbin of Figure 6. Figure 8 is a side view of the coil winding bobbin of Figure 6. Figure 9 is a top view of the coil winding bobbin of Figure 6. These figures show one tapering that can be implemented within the coil winding for the present invention.

a first and second yoke portion;  
at least one shim between one yoke portion and one of the pair of spaced apart magnets;  
a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall; and,  
a reed having a central portion which extends through the tunnel, a stationary end, and a deflection end, wherein the reed has a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective magnets, wherein the coil has a first end toward the stationary end of the reed and a second end toward the magnets, and wherein the magnets have a second end toward the deflection end of the reed and a first end toward the coil.

32. The transducer of claim 31 wherein at least a stretch of the at least one of the upper and lower tunnel walls of the magnets is tapered outwardly from the central axis moving in a direction toward the second end of the magnets, the tapering being caused by the at least one shim between the one yoke portion and the one of the pair of spaced apart magnets.

33. The transducer of claim 31 wherein the at least one of the upper and the lower tunnel walls of the magnets is tapered outwardly from the central axis from the first end of the magnets to the second end of the magnets, the tapering being caused by the tapering of the at least a part of one of the first and second yoke portions being tapered along the side of the yoke portion adjacent the one of the pair of magnets.

34. A transducer (2) comprising a pair of spaced magnets (6,8) at least partially forming a tunnel (10), the tunnel (10) having a central axis (12), the

magnets (6,8) having an upper and a lower tunnel wall (40, 42), a coil (14) at least partially forming the tunnel (10) having a first and a second side wall (16, 18) and an upper and lower wall (20, 22); and a reed (24) having a central portion (26) which extends through the tunnel (10), a stationary end (28), and a deflection end (30), wherein the reed (24) has a tip portion (30) which lies at least partially between the magnets (6,8), wherein the reed (24) is mounted for deflection towards or away from the respective magnets (6,8), wherein the coil (14) has a first end (32) toward the stationary end (28) of the reed (24) and a second end (34) toward the magnets (6, 8), wherein the magnets (6, 8) have a second end (44) toward the deflection end (30) of the reed (24) and a first end (46) toward the coil (14), characterized in that at least one of the upper and the lower tunnel walls (40, 42) of the magnets (6, 6) has a raised portion (80) inwardly toward the central axis (12) toward the first end (46) of the magnets (6, 8).

35. The transducer of claim 34 wherein the raised portion extends substantially the width of the tunnel.

36. A transducer comprising:

a housing;

a pair of spaced magnets at least partially forming a tunnel, the tunnel having a central axis, the magnets having an upper and a lower tunnel wall;

a coil at least partially forming the tunnel having a first and a second side wall and an upper and lower wall;

an armature having a reed with a central portion which extends through the tunnel, having a stationary end, and having a deflection end, wherein the reed further having a tip portion which lies at least partially between the magnets, wherein the reed is mounted for deflection towards or away from the respective

# ENT COOPERATION TREATY

From the INTERNATIONAL SEARCHING AUTHORITY

To:  
WALLENSTEIN & WAGNER, LTD.  
Attn. MORNEAULT, Monique A.  
311 South Wacker Drive - 5300  
CHICAGO, ILLINOIS 60606  
UNITED STATES OF AMERICA

RECEIVED  
JUL 10 2001  
WALLENSTEIN & WAGNER

PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL SEARCH REPORT  
OR THE DECLARATION

(PCT Rule 44.1)

Date of mailing  
(day/month/year) 05/07/2001

Applicant's or agent's file reference

328 P 458

FOR FURTHER ACTION

See paragraphs 1 and 4 below

International application No.

PCT/US 00/27522

International filing date  
(day/month/year)

06/10/2000

Applicant

KNOWLES ELECTRONICS, LLC

1. ☒ The applicant is hereby notified that the International Search Report has been established and is transmitted herewith.

**Filing of amendments and statement under Article 19:**

The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46):

**When?** The time limit for filing such amendments is normally 2 months from the date of transmittal of the International Search Report; however, for more details, see the notes on the accompanying sheet.

**Where?** Directly to the International Bureau of WIPO  
34, chemin des Colombettes  
1211 Geneva 20, Switzerland  
Facsimile No.: (41-22) 740.14.35

For more detailed instructions, see the notes on the accompanying sheet.

2. ☐ The applicant is hereby notified that no International Search Report will be established and that the declaration under Article 17(2)(a) to that effect is transmitted herewith.

3. ☐ With regard to the protest against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

☐ the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

☐ no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

**Further action(s):** The applicant is reminded of the following:

Shortly after 18 months from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau as provided in Rules 90bis.1 and 90bis.3, respectively, before the completion of the technical preparations for international publication.

Within 19 months from the priority date, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase until 30 months from the priority date (in some Offices even later).

Within 20 months from the priority date, the applicant must perform the prescribed acts for entry into the national phase before all designated Offices which have not been elected in the demand or in a later election within 19 months from the priority date or could not be elected because they are not bound by Chapter II.

Name and mailing address of the International Searching Authority

 European Patent Office, P.B. 5818 Patentlaan 2  
NL-2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

Authorized officer

Marie-Françoise Provot

@: Yhs, @lnt

Art 19 → 9.05.01

JP

## NOTES TO FORM PCT/ISA/220

These Notes are intended to give the basic instructions concerning the filing of amendments under article 19. The Notes are based on the requirements of the Patent Cooperation Treaty, the Regulations and the Administrative Instructions under that Treaty. In case of discrepancy between these Notes and those requirements, the latter are applicable. For more detailed information, see also the PCT Applicant's Guide, a publication of WIPO.

In these Notes, "Article", "Rule", and "Section" refer to the provisions of the PCT, the PCT Regulations and the PCT Administrative Instructions respectively.

### INSTRUCTIONS CONCERNING AMENDMENTS UNDER ARTICLE 19

The applicant has, after having received the international search report, one opportunity to amend the claims of the international application. It should however be emphasized that, since all parts of the international application (claims, description and drawings) may be amended during the international preliminary examination procedure, there is usually no need to file amendments of the claims under Article 19 except where, e.g. the applicant wants the latter to be published for the purposes of provisional protection or has another reason for amending the claims before international publication. Furthermore, it should be emphasized that provisional protection is available in some States only.

#### What parts of the international application may be amended?

Under Article 19, only the claims may be amended.

During the international phase, the claims may also be amended (or further amended) under Article 34 before the International Preliminary Examining Authority. The description and drawings may only be amended under Article 34 before the International Examining Authority.

Upon entry into the national phase, all parts of the international application may be amended under Article 28 or, where applicable, Article 41.

#### When?

Within 2 months from the date of transmittal of the international search report or 16 months from the priority date, whichever time limit expires later. It should be noted, however, that the amendments will be considered as having been received on time if they are received by the International Bureau after the expiration of the applicable time limit but before the completion of the technical preparations for international publication (Rule 46.1).

#### Where not to file the amendments?

The amendments may only be filed with the International Bureau and not with the receiving Office or the International Searching Authority (Rule 46.2).

Where a demand for international preliminary examination has been/is filed, see below.

#### How?

Either by cancelling one or more entire claims, by adding one or more new claims or by amending the text of one or more of the claims as filed.

A replacement sheet must be submitted for each sheet of the claims which, on account of an amendment or amendments, differs from the sheet originally filed.

All the claims appearing on a replacement sheet must be numbered in Arabic numerals. Where a claim is cancelled, no renumbering of the other claims is required. In all cases where claims are renumbered, they must be renumbered consecutively (Administrative Instructions, Section 205(b)).

The amendments must be made in the language in which the international application is to be published.

#### What documents must/may accompany the amendments?

##### Letter (Section 205(b)):

The amendments must be submitted with a letter.

The letter will not be published with the international application and the amended claims. It should not be confused with the "Statement under Article 19(1)" (see below, under "Statement under Article 19(1)").

The letter must be in English or French, at the choice of the applicant. However, if the language of the international application is English, the letter must be in English; if the language of the international application is French, the letter must be in French.

## NOTES TO FORM PCT/ISA/220 (continued)

The letter must indicate the differences between the claims as filed and the claims as amended. It must, in particular, indicate, in connection with each claim appearing in the international application (it being understood that identical indications concerning several claims may be grouped), whether

- (i) the claim is unchanged;
- (ii) the claim is cancelled;
- (iii) the claim is new;
- (iv) the claim replaces one or more claims as filed;
- (v) the claim is the result of the division of a claim as filed.

The following examples illustrate the manner in which amendments must be explained in the accompanying letter:

1. [Where originally there were 48 claims and after amendment of some claims there are 51]:  
"Claims 1 to 29, 31, 32, 34, 35, 37 to 48 replaced by amended claims bearing the same numbers; claims 30, 33 and 36 unchanged; new claims 49 to 51 added."
2. [Where originally there were 15 claims and after amendment of all claims there are 11]:  
"Claims 1 to 15 replaced by amended claims 1 to 11."
3. [Where originally there were 14 claims and the amendments consist in cancelling some claims and in adding new claims]:  
"Claims 1 to 6 and 14 unchanged; claims 7 to 13 cancelled; new claims 15, 16 and 17 added." or  
"Claims 7 to 13 cancelled; new claims 15, 16 and 17 added; all other claims unchanged."
4. [Where various kinds of amendments are made]:  
"Claims 1-10 unchanged; claims 11 to 13, 18 and 19 cancelled; claims 14, 15 and 16 replaced by amended claim 14; claim 17 subdivided into amended claims 15, 16 and 17; new claims 20 and 21 added."

### "Statement under article 19(1)" (Rule 46.4)

The amendments may be accompanied by a statement explaining the amendments and indicating any impact that such amendments might have on the description and the drawings (which cannot be amended under Article 19(1)).

The statement will be published with the international application and the amended claims.

It must be in the language in which the international application is to be published.

It must be brief, not exceeding 500 words if in English or if translated into English.

It should not be confused with and does not replace the letter indicating the differences between the claims as filed and as amended. It must be filed on a separate sheet and must be identified as such by a heading, preferably by using the words "Statement under Article 19(1)."

It may not contain any disparaging comments on the international search report or the relevance of citations contained in that report. Reference to citations, relevant to a given claim, contained in the international search report may be made only in connection with an amendment of that claim.

### Consequence if a demand for international preliminary examination has already been filed

If, at the time of filing any amendments under Article 19, a demand for international preliminary examination has already been submitted, the applicant must preferably, at the same time of filing the amendments with the International Bureau, also file a copy of such amendments with the International Preliminary Examining Authority (see Rule 62.2(a), first sentence).

### Consequence with regard to translation of the international application for entry into the national phase

The applicant's attention is drawn to the fact that, where upon entry into the national phase, a translation of the claims as amended under Article 19 may have to be furnished to the designated/elected Offices, instead of, or in addition to, the translation of the claims as filed.

For further details on the requirements of each designated/elected Office, see Volume II of the PCT Applicant's Guide.

# PATENT COOPERATION TREATY

# PCT

## INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference <b>328 P 458</b>	<b>FOR FURTHER ACTION</b> see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.	
International application No. <b>PCT/US 00/ 27522</b>	International filing date (day/month/year) <b>06/10/2000</b>	(Earliest) Priority Date (day/month/year) <b>07/10/1999</b>
Applicant  <b>KNOWLES ELECTRONICS, LLC</b>		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 2 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

### 1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☐ the text is approved as submitted by the applicant.

☒ the text has been established by this Authority to read as follows:

**ELECTRO-ACOUSTIC TRANSDUCER WITH RESISTANCE TO SHOCK-WAVES**

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

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☐ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☒ because this figure better characterizes the invention.

☐ None of the figures.



## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/27522

**A. CLASSIFICATION OF SUBJECT MATTER**  
IPC 7 H04R11/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**Minimum documentation searched (classification system followed by classification symbols)  
IPC 7 H04R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 647 013 A (SALVAGE RICHARD JAMES ET AL) 8 July 1997 (1997-07-08) cited in the application	1
X	column 3, line 28 - line 49; figures 8-12	10-27
X	US 3 617 653 A (TIBBETTS GEORGE C ET AL) 2 November 1971 (1971-11-02) column 4, line 50 - line 53; figure 3	27, 28, 30
X	US 1 871 739 A (A. RINGEL) 16 August 1932 (1932-08-16) page 2, column 1, line 50 - column 2, line 106; figures 1, 3	36-38
A	US 4 272 654 A (CARLSON ELMER V) 9 June 1981 (1981-06-09) column 3, line 29 - line 41; figures 1, 3	34

☐ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

## \* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

Date of the actual completion of the international search

5 February 2001

Date of mailing of the international search report

05/07/2001

Name and mailing address of the ISA

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Authorized officer

Anderson, A

**FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210**

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-9

A transducer comprising active shock protection means.

2. Claims: 10-26

A transducer having a tapered coil which also has raised portions.

3. Claims: 27-30

A transducer having a tapered magnet.

4. Claims: 31-33

A transducer having a shim.

5. Claims: 34-35

A transducer having a magnet with raised portions.

6. Claims: 36-38

A transducer having a spacer.

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US 00/27522

## Box I Observations where certain claims were found unsearchable. (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/27522

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5647013 A	08-07-1997	AT 162038 T	15-01-1998
		AU 682831 B	23-10-1997
		AU 5284193 A	24-05-1994
		CA 2146969 A	11-05-1994
		DE 69316233 D	12-02-1998
		DE 69316233 T	28-05-1998
		DK 667093 T	07-09-1998
		EP 0667093 A	16-08-1995
		EP 0784415 A	16-07-1997
		EP 0924961 A	23-06-1999
		WO 9410817 A	11-05-1994
		JP 8502635 T	19-03-1996
US 3617653 A	02-11-1971	BE 715072 A	13-11-1968
		CH 494514 A	31-07-1970
		DE 1762265 A	16-04-1970
		FR 1575802 A	25-07-1969
		GB 1234273 A	03-06-1971
		JP 48013441 B	27-04-1973
		LU 56089 A	10-02-1969
		NL 6806874 A,C	18-11-1968
US 1871739 A	16-08-1932	NONE	
US 4272654 A	09-06-1981	NONE	